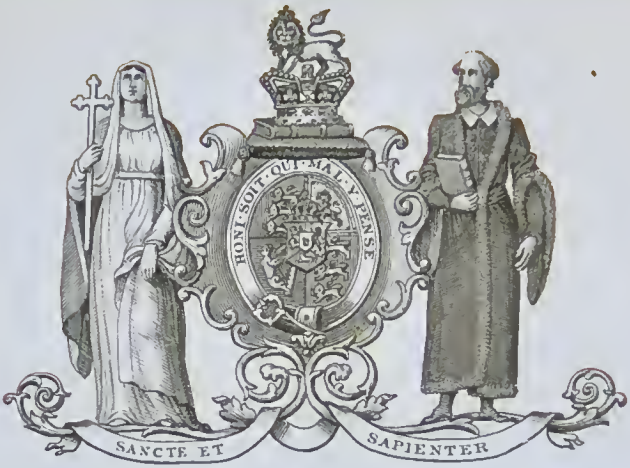

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A MANUAL

FOR THE

PRACTICE

OF

SURGERY

BY

THOMAS BRYANT, F.R.C.S.

SURGEON TO, AND LECTURER ON SURGERY AT, GUY'S HOSPITAL.
MEMB. CORRESPOND. DE LA SOCIÉTÉ DE CHIRURGIE DE PARIS

WITH SIX HUNDRED AND SEVENTY-TWO ILLUSTRATIONS

Third Edition, Revised and Enlarged

VOL. I.



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PREFACE TO THIRD EDITION.

In presenting to my professional brethren the Third Edition of a book which has been so kindly received as this, I have only to express a hope that it will not prove less acceptable than its predecessors. The whole has been carefully revised, much of it has been re-written, important additions have been made to almost every chapter, and, of the six hundred and seventy-two woodcuts, eighty-eight are new, and many coloured.

THOMAS BRYANT.

53, Upper Brook Street,
Grosvenor Square;
London, *December*, 1878.

PREFACE TO SECOND EDITION.

A SECOND EDITION of this manual having been called for, I have availed myself of the opportunity to make some alterations in the substance as well as in the arrangement of the work, and, with a view to its improvement, have recast the materials and revised the whole. I have, also, to make the work more complete, added much new matter, including chapters on diseases and injuries of the eye and ear, some remarks on dental surgery, on the diagnosis of ovarian tumours, and on deformities, together with at least one hundred new woodcuts.

The book has also, for the sake of greater convenience, been divided into two volumes, the first including the elementary principles of our art, general subjects, tumours, the surgery of the cutaneous, lymphatic, nervous, circulatory, and digestive systems; and the second the surgery of the respiratory, urino-genital, muscular, and osseous systems, gunshot wounds and amputations, with a full general index.

I am well aware that I have failed to realise, in the execution of my task, the ideal standard I, at starting, proposed to myself, and I knew when I first undertook to write the book how difficult it was to compress the treatment of the vast range of subjects included under the title of Surgery into one volume; but my object was to offer such an epitome of the main principles and methods of practice as should be serviceable to the student and practitioner; and from the reception the first edition of this work, published in November, 1872, has met with in Great Britain and America, I feel justified in saying

that I have not failed in the attempt, and that the book supplied a want felt by the professional public.

To the many reviewers, who have acknowledged my labours so fairly and so fully, my thanks are clearly due, but still more to the profession which has welcomed my humble services so kindly.

Fully alive, therefore, to the generous appreciation of my past work, and assuring my readers that no pains have been spared to bring the present up to as high a standard as my time and opportunities have allowed, I submit it in all confidence to the kind consideration of my professional brethren as no unworthy exposition of modern British Surgery.

In its execution I have endeavoured to acknowledge on all occasions the claims of others, and whatever merit or novelty may attach to their views or operations; for my wish has been to represent not so much my own opinion as the position of Surgery at the time I write.

It only remains for me to express once more my obligations to Mr. Thomas Turner, the Treasurer of Guy's Hospital, by whose kindness the materials in the unrivalled collections of that institution were placed at my disposal; to my colleagues, Drs. Moxon, Goodhart, and Purves, Messrs. Howse, C. Higgens, and Moon; and to Mr. Wesley, the artist who has so ably illustrated these pages.

Since I first undertook this work death has deprived me of two colleagues, Mr. Poland and Dr. Phillips, both of whom rendered me many friendly services and much valuable assistance. I refer to their names with gratitude and regret.

53, Upper Brook Street,
Grosvenor Square;
March, 1876.

VOLUME FIRST.

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"Only the association of medicine with surgery forms the perfect physician. The physician who is deficient in the knowledge of one of these branches resembles a bird with but one wing."

Art of Life (Ayur Veda): early Sanscrit, first century of Christian era.

"Surgery consists in curing a disease rather than in the removal of it by mechanical means. But so differently do most think upon this subject that a surgeon who performs most operations and gives most pain is commonly thought the best."

John Hunter, MS. Lectures, 1787.

THE

PRACTICE OF SURGERY.

INTRODUCTORY CHAPTER.

SURGERY is of a twofold nature. It is a science and also an art—a department that requires to be known and another to be practised. The science embraces a knowledge of the character, the causes, and the effects of disease and injury, and also of the processes by which they are best repaired; the art, the treatment of diseases or injuries as they present themselves. The latter, however, in order to be successful, must be based upon science, and science must be supported by observation, at the bedside, where the phenomena of disease must be studied, and the symptoms recognised as well as duly weighed; and also in the post-mortem room, where the effects are to be traced. The great object of the student, therefore, should be clinical and pathological investigation, the study of the living and the dead. It is by this alone he can hope to acquire a solid basis on which to ground his practice.

Skilled and unskilled observation.

The external features of a local disease may appear the same to the student as to the most accomplished practitioner; whereas the phenomena of disease are often perceptible to the surgeon alone—the acquired art of observation and the unconscious influence of experience giving to the mind of the one a power of recognition and interpretation which is denied to others.

It is to the acquisition of this power, therefore, that the student should devote his energies, and to this end cultivate the art of observation, for by it he will not only gain the power of seeing correctly, but also of interpreting the meaning of what he sees, and will thereby acquire a diagnostic acumen which cannot otherwise be obtained.

On diagnosis.

It is now necessary to consider by what method a correct opinion can be formed in any given instance; how sources of fallacy are best eliminated and a good diagnosis established, for it cannot be too forcibly impressed upon a student's mind that the treatment of a case will not be successful unless based on a clear understanding of its wants, and that these can never be duly appreciated where a correct diagnosis of its nature has not been made.

The mind of the surgeon should invariably be judicial, and possess nothing of the advocate, it should be so regulated as to be able to put aside all prejudices and preconceived ideas, suppress the advocacy of all unsupported theories and hypotheses, accept clinical phenomena as they are observed, and arrive at a conclusion cautiously and clearly after duly balancing the facts of the case, and carefully weighing the possibilities and probabilities of its nature.

Its principle. To form a diagnosis of a case mainly on probabilities as indicated by symptoms may be a ready, but it will always prove a rash proceeding. To form it on possibilities will be a safe, although, perhaps, a less expeditious course. The Surgeon who acts upon the first method must, at times, fall into grave errors, although his diagnosis will often appear brilliant and be successful; while he who habitually forms an opinion after taking into consideration every possibility of the case, and comes to a result by a process of exclusion, must surely, on the whole, be more certain in his ends, as he will be safer and sounder in his practice. I lay down therefore the following proposition as a guiding principle of investigation applicable alike to all cases of injury as well as of disease.

Reasoning by exclusion. *That in the diagnosis of a case, every possibility of its nature should be entertained, and a conclusion arrived at by a process of elimination; each possibility should be separately considered and weighed, and the most probable finally accepted; a diagnosis wholly framed on probabilities being most hazardous.*

Example. For example, a tumour at the femoral ring may *possibly* be an abscess, an aneurism, or a varix, cyst, hernia, enlarged gland, or a new growth. An abdominal tumour may be ovarian, uterine, peritoneal, vesical, splenic, fæcal, renal or hydatid. Its probable nature will be best arrived at by eliminating each of these possibilities *seriatim* after a due consideration of all its clinical symptoms: the most probable diagnosis being finally accepted on evidence both negative and positive.

How to diagnose. With the above great principle of practice as a guide in clinical investigation, I now proceed to consider how any injury or disease is to be investigated, confining my observations to classes of injury and disease. I do not propose, however, to point out here the exact mode in which it is well to examine a case or to report it—for a report is only a written examination—although at pages 7 and 8 an outline will be seen, which may probably be found of service. I drew it out many years ago when surgical registrar at Guy's, where it has been generally followed ever since.

How to Investigate a Case.

When a surgeon is called to a patient, his questions naturally apply first of all to the seat of disease or injury. Is it in the head, chest, abdomen, or extremities? He will then ask as to its duration or when the injury was received? or when was the disease discovered? If a case of injury, his inquiries would tend to elicit the exact mode of its production, the force employed, and the character of the instrument by which it was produced; for these points are of essential importance under all circumstances, and in head injuries they often give the key to the solution of many questions. By these means the exact seat of injury will probably be indicated, and the Surgeon will be led to make a close examination of the injured part; but he should never fail to assure himself that all other parts of the body are sound and in working order, and that no other is involved in disease, or is the subject of injury; for it would be a forlorn hope to amputate for a crushed limb when associated with a ruptured liver, or to reduce a dislocated joint when combined with some fatal internal lesion.

In a case of injury to or disease of the head or nervous system, the most important point the surgeon has to determine has reference to the

exact seat of the affection. Is it confined to the soft parts covering the bone, or are the contents of the skull in any way involved? because, in the former, the affection is comparatively of small importance; while in the latter, its gravity cannot be too highly estimated. Scalp wounds, however severe, have as a rule a successful ending; whilst brain injuries, however trivial, should always be regarded with apprehension, for they may lead to the most serious complications. Example, brain injury.

When no signs of brain disturbance after an injury have been observed the diagnosis is not difficult, for without symptoms, local or general, a surgeon may be excused from entertaining the idea of brain complication; although he should know that fatal cases of fractured base have taken place without any symptoms to suggest the presence of such an injury. When indications of brain disturbance exist, the difficulty arises, for it cannot be too firmly impressed on the student's mind that the same symptoms may be produced by concussion as by compression of the brain; and that bone pressing on the brain, and blood effused upon its surface, or within its structure, give rise to precisely the same phenomena; he should know that the symptoms produced by apoplexy the result of a ruptured vessel, and by hæmorrhage into the brain from an injury, are almost identical, and that those produced by what is called functional disturbance of the brain closely resemble those caused by organic mischief. Whilst, therefore, it is imperative on the student of surgery to remember, that a variety of different conditions may give rise to apparently identical clinical symptoms; he must know that the clinical *history* of each of these cases will, on inquiry, be found to differ widely, and that it is to the collateral evidence of the case he must look, to find the right clue to a successful diagnosis. Value of clinical history.

Where no clinical history can be obtained, the difficulties of diagnosis are indeed great; thus, when a surgeon is called to see a man who has been found in the street, insensible; who is in fact in an apoplectic condition, and has, at the same time, some external evidence of injury to his skull; and may perhaps also smell of spirits. The questions that arise in the surgeon's mind under these circumstances are very conflicting. Did this man have a fit and then fall? or, are the symptoms due to a brain injury, the result of an accident? Was he knocked down and injured, or, was the injury the consequence of a fall? Are the symptoms caused by drunkenness, or how far are they complicated with it? Are they the result of blood-poisoning from kidney disease, or, poisoning by opium?

To unravel all these points great care and discrimination are required. Too much, indeed cannot be bestowed upon the task, because to treat an apoplectic seizure, or a case of severe brain injury from external violence, for drunkenness, is a grave error; but, unfortunately, it is one which is not uncommon. To mistake drunkenness for apoplexy or severe head injury, is, perhaps, a less grave, although it is, without doubt, a serious fault. As a matter of practice, however, it is generally a wise rule to regard all these suspicious cases from the more serious point of view, and to watch and wait for symptoms to indicate the practice that should be pursued. Rule to adopt.

What I wish therefore to impress upon the student is the necessity of bearing in mind that all these different conditions alluded to present to the surgeon many features in common, and that a correct diagnosis can only be arrived at by a process of exclusion. The

possibilities of the case having thus been reviewed, the probabilities can only be weighed by a rigid inquiry, even into the minutest circumstances that can be ascertained.

Example, local paralysis.

In cases of local paralysis the difficulties of diagnosis are very great. Is the cause a *central* one—that is, is it in the brain or cord? or is it *peripheral*—at the termination of the nerves? or, is it *local* without being quite peripheral?

If one of the two former causes be in operation, the history of the case will probably form a true guide to the surgeon; and in the latter some local injury to the nerves supplying the part, some tumour or aneurism pressing upon the nerves, will probably be found; or, perchance it may be a case of lead palsy or infantile paralysis. But under any circumstances, a true diagnosis can only be made by eliminating from consideration the many possible causes and adopting the most probable.

Compare sound with affected side.

Again, *It should be an invariable rule of practice in every case of injury or disease, to compare the sound with the affected side of the body.* In the diagnosis of a dislocation or fracture, the information gained by the comparison is always of great value, and furnishes often to the experienced eye a true suggestion as to the nature of the accident. In joint disease, also, the practice is of equal importance; any effusion into a joint, or enlargement of the bones being, as a rule, readily detected on making the comparison.

The nature of the disease or injury being thus suggested to the mind through the eye, the suggestion remains to be confirmed or corrected by a careful manual examination, by the other clinical symptoms, and by the history of the case; the facts elicited by the sight, by the hand, and by the ear, being made separately available, and the conclusion drawn after a careful balancing of the probabilities and possibilities of the case. The diagnosis will be well established when all these different modes of investigation lead to one conclusion. In surgery as in medicine the student must educate the eye to see and the hand to feel. The task is by no means simple or easy; indeed, it is one of the most difficult to learn, and cannot be begun too early in a professional career. Reading will not help, nor thought aid; personal experience at the bedside alone will supply the want.

Bedside experience.

To recognise the existence of a wound, or the deformity of a broken bone, may not be difficult; but to read aright the endless phenomena which a wound presents, and to make out the character or tendency of a fracture, requires much experience. To see that a swelling exists in a part is open to the uneducated eye; but to recognise the various aspects that different tumours assume, to make out their form, position, and attachments, to estimate their consistence, to recognise the fluctuation of fluid, whether superficial or deep, and to detect pulsation, require considerable tactile power and long education. What education also is demanded in order to read the phenomena presented in diseases of the eye or the skin! "No study of the written observations of others could enable any to appreciate those endless varieties of the pulse which entirely baffle description, or to distinguish between the warmth of the skin, excited by various accidental causes, and the pungent heat accompanying the first stage of pneumonia, or acquaint him with the shrunk and shrivelled features derived from the long-continued disease of the abdominal viscera—the white and bloated countenance often attendant on changes in the functions or structure of the kidney—the squalid

and mottled complexion of the cachexia dependent upon the united effects of mercury and syphilis—the pallid face of hæmorrhage—the waxen hue of amenorrhœa—the dingy whiteness of malignant disease—the vacant lassitude of fever—the purple cheek of pneumonia—the bright flush of phthisis—the contracted features and corrugated brow of tetanus; all which shades of countenance, with many more that might be enumerated, are distinctly recognised by the experienced eye." (Dr. Bright, 'Guy's Hosp. Rep.,' 1836.) Yet all this, and something more, is to be acquired by means of trained observation, and no labour on the student's part should be considered too great for its attainment.

On Diathesis.

The subject of *Diathesis* claims the attention of the surgeon, on account of its undoubted bearing on practical surgery. In the *strumous*, *scrofulous*, and *tuberculous diathesis*, all of which appear to be closely allied, there is, no doubt, a tendency to glandular enlargement, the formation of caseous deposits and a low kind of inflammatory action, whether in the bones, joints, skin, or lungs; but beyond these clinical facts we know nothing. Disease in subjects who have these diatheses is precisely identical in its essential nature with the same disease as found in others who have them not. It may be modified in its course by the diathesis, but it is the same. These names have, likewise, no special signification when applied to local affections.

It is important to bear this fact in mind, for there can be little doubt that the expressions "strumous disease" and "scrofulous disease" have had an injurious influence on the practice of surgery. They have too often led the surgeon (and misled the public) to regard a local affection in a strumous or scrofulous subject as incurable, as depending on some constitutional condition, and not on a local cause. In disease of the joints this error has been much felt, and should be rejected.

Scrofulous.

The modern investigations of Drs. Sanderson and Fox in our own country, and Dr. Waldenburg[1] abroad, tend, however, to show that the *scrofulous* diathesis, in which there is a tendency to inflammation of a low type, gives rise, under some circumstances, to *tuberculosis*, and that local inflammatory affections of a chronic nature are specially prone to be followed by tuberculous disease. The grey granulations or tubercles are apparently derived from some pre-existing inflammation; from the absorption into the blood of the *caseous* or *cheesy* deposits which are supposed to be the residue of an antecedent inflammatory action—whether in the bones, joints, glands, or lungs—and these are subsequently disseminated in the form of miliary tubercle. Niemeyer, indeed, maintains that "the formation of tubercle never takes place unless preceded by pneumonia, terminating in caseous infiltration of the pulmonary tissue." To the surgeon this aspect of the case is of immense importance, for it is clearly his duty, under these circumstances, to hasten the recovery of local suppurative disease as much as possible, and where this cannot be carried out, to remove it. For let it be once shown that local disease has a direct influence in producing constitutional dyscrasia—call it by what name we will—and the necessity of dealing actively with chronic local affections becomes a duty. I have occasionally acted upon this principle with the best results, and in more than one case in which there was progressive lung mischief associated with a disorganised knee have found the lung affection speedily subside after amputation. It

Connection between local suppurative disease and tubercle.

[1] 'Die Tuberculose und Scrofulose,' von Dr. L. Waldenburg. Berlin. 1869.

must likewise be admitted that a local disease in a strumous subject, may be as amenable to treatment as it is in a more healthy one. The treatment may indeed require some modification from the fact of its occurring in such a subject, but the principles of practice in both, the strumous and the non-strumous, are the same, although we know that in the former all diseased action is of a low type, and that there is always a greater tendency to degenerative changes than we find in other subjects. Some pathologists have been bold enough to say that the scrofulous diathesis is the consequence of hereditary syphilis, but evidence is wanting to substantiate this view.

Hæmorrhagic.

Hæmophilia, or the *hæmorrhagic* diathesis, is a subject of peculiar interest to the surgeon. That it is generally hereditary there can be no doubt, and in some instances it affects several members of the same family. It is shown by a peculiar tendency to bleeding on the slightest provocation, and by the difficulty there is in arresting hæmorrhage when it does take place. The surgeon should always have before him the possibility of his patient being a subject of this diathesis; for although it would not prevent the performance of any operation essential to save life, it would materially affect the question of operating for any reason of expediency, and would influence the practice adopted.

The bleeding may take place from any part of the body, or into any cavity. It may be venous or arterial and may occur without any definite cause, or follow some slight injury. Sir W. Jenner states that in these cases "the tissues are soft and bruise easily; the blood is slow in coagulating, although it coagulates as firmly as in health; that is, blood is formed rapidly, and there is a tendency to plethora of the small vessels, and that when the patient is looking his best, injuries have the worst effect, and spontaneous hæmorrhages are most likely to occur." In this disease, therefore, he advises a mercurial and saline purge every three weeks, dry food, with a considerable portion of dry fibrinous meats, and plenty of open-air exercise; great care being observed to avoid injuries.

A few words now respecting *cachexiæ*.

On cachexiæ.

Do they exist? Is there any definite aspect associated with any definite disease? Is there a cancerous cachexia? I have little hesitation in stating that in practice no such thing can be established, and, that a large number of patients suffering from cancer are as healthy looking as any other class, if not often healthier. There can be no doubt that a patient, suffering from cancer which, by its discharges or development, interferes with the important functions of life, and undermines his powers, has an anxious, drawn, bloodless, and waxy appearance; but so has the subject of any organic disease which interferes with the functions of digestion and assimilation, and particularly the subject of intestinal disease. The patient exhausted by suppuration, by spinal, bone, or joint mischief; the man or woman who from drink, syphilis, or mercury (separately or combined), is gradually being brought down to death's door, has a cachexia more or less peculiar according to the organ involved in the disease, and the special constitution of the patient; but it is merely the condition of looking ill. Clinically, I read the meaning of a cachexia as "looking ill," perhaps very ill, from some long-standing or slowly-acting cause; but it has no other definite signification than "looking ill" from cancer, "looking ill" from abdominal, rectal, suppurative, or syphilitic disease.

POINTS FOR ENQUIRY IN SURGICAL CASES.

Disease or Injury. Date when seen. Result.

NAME, age, occupation, residence, general health, habits, and aspect. In some cases hereditary history.

HISTORY OF PRESENT DISEASE OR INJURY.—Its assigned cause or method of production.

ORDER OF SUCCESSION OF SYMPTOMS, with their former treatment, and date of any marked change in either symptoms or treatment.

PRESENT CONDITION AND APPEARANCES; passing in review, and noting when irregular the condition of intellect, senses, and nervous system. Organs of respiration and circulation. Pulse—frequency, force, volume, compressibility, distinctness and rhythm. Temperature. Digestive Organs—tongue, appetite, bowels. Urino-genital Organs—urine, catamenia. Integuments—eruptions, moist or dry;—above or below natural heat. Locomotive organs—bones, joints, and muscles, whether paralysed or in undue action.

PREVIOUS DISEASES OR INJURIES, with their dates. Treatment.

PROGRESS OF THE CASE.—Note carefully any change in the old, or the appearance of new symptoms, with the date of change, and treatment, by medicine, diet, &c., &c. Carefully fill in the result, and date of departure; if unfavorable, the condition on post-mortem examination.

NOTE.—As the value of a Report depends upon its conciseness, together with the accuracy and number of recorded observations, it is unnecessary to write one, unless an appreciable change in the symptoms exists.

SPECIAL POINTS FOR OBSERVATION.

HERNIA.—Variety and character—its position, period of existence, assigned cause, and form; whether previously irreducible, and if a truss had been worn.

When STRANGULATED, give the symptoms, *general and local*, dating from the exact period of strangulation, the first appearance of sickness, character of vomit.

PREVIOUS AND PRESENT TREATMENT.—If by *taxis*, state whether forcible, and how long applied, with or without chloroform; when by *operation*, if sac was opened or not—if opened, *why?* its contents and their appearances. On reduction, note the time from the first symptoms of strangulation; success, immediate and final.

WOUNDS.—Variety, position, extent, and depth; how, and with what produced; *when on scalp*, if exposing bone. Complications—hæmorrhage, &c. Treatment and result—whether united by adhesion or granulation.

TETANUS.—Idiopathic or Traumatic, partial or general; time of appearance after injury; position and condition of wound. Death—whether from spasm or exhaustion.

DISLOCATIONS.—Form and position; simple or compound; how and when produced; previous Treatment.

SYMPTOMS, general appearance and position of the limb; mobility, pain, amount of injury to soft parts. Treatment—time after injury; by manipulation or extension; mode of application of extension; its direction, duration, and additional means, under chloroform. Result, immediate and final.

FRACTURES.—Simple or compound; how and when produced; position and direction of the line of fracture; its tendency; amount of injury to vessels and soft parts; in *Compound*, note position, and extent of wound; if produced by the primary force or broken bone, what vessels, nerves, or joints are involved. Constitutional symptoms.

TREATMENT.—Sand bags, starch bandage, splints, form of splint applied; date of application. Note the date of any change of local or general Treatment.

FRACTURED SKULL.—Position; kind of injury and direction of the force; if attended by hæmorrhage, its amount, and whether from nose, mouth, ear, or external wound. Give evidence, if any, of brain mischief.

IN SUSPECTED FRACTURED BASE.—Paralysis of facial nerve; flow of blood or serum from ear, with the time of its first appearance after the injury and its duration; condition of hearing; state of vision, and of pupils; presence of subconjunctival hæmorrhage. If complicated with internal injury, as *concussion, compression, &c.*; carefully report symptoms in their order of succession, and whether immediately following the injury or not; the duration, and amount of unconsciousness, insensibility; paralysis, its position, motion, sensation, or both; condition of sphincters; character and number of pulse, respiration; condition of skin. Treatment, &c.

DISEASED BONE.—Part affected; duration; cause, as external injury, syphilis, mercury; extent, superficial or deep, partial, or general; previous Treatment, especially as regards operations.

PRESENT SYMPTOMS AND APPEARANCES.—Condition of dead bone or *Sequestrum*, fixed or loose; number and position of openings, or *external cloacæ*, with the date of their first appearance.

TREATMENT.—If by operation, its immediate success.

DISEASES OF JOINTS.—Part affected; date of first discovery; assigned cause, as injury. Note the early symptoms, in the order of their appearance; and date of any fresh symptom or marked change; if pain or uneasiness preceded swelling, or was coeval with it; if the former, how long? Rapidity of progress; previous Treatment, and its effects.

PRESENT APPEARANCES.—Position of joint; if flexed, the angle of flexure; size and shape.

CHARACTER OF SWELLING.—Uniform or bulging; manipular indications, hard, soft, elastic, or fluctuating; mobility, amount; if attended with grating, &c.; in the knee-joint, note if the patella be free or not; if free, the sensation felt on moving it; condition of skin; if fistulous openings exist; their position, number, and character of their discharge; deep or superficial; note the date of their first appearance, and if natural or artificial. Pain, acute or gnawing; its position, general or local; if aggravated by motion, or interarticular pressure; if increased at night. Sleep, if disturbed by crying or starting of the limb; sympathetic pain, and its position; condition of muscles of limb; constitutional symptoms. Treatment.

STRICTURE,—Organic or traumatic; duration and assigned cause, especially as regards gonorrhœa; use of injections, or accident; if previously treated by Catheter; complications, as abscess, fistula, with their position and date of appearance.

RETENTION.—Mention period of retention; preceding symptoms, and cause, as stricture, calculus, paralysis, abscess, prostatic disease, &c. Constitutional and local symptoms; previous and present Treatment; pressure per rectum, note the date of removal of the canula and arrest of the flow of urine through the wound.

EXTRAVASATION.—Cause, over-distension or accident; duration of retention before urethra gave way, and period that elapsed before being seen. Describe the appearances and extent of parts infiltrated; constitutional symptoms and Treatment.

VENEREAL DISEASE.—Chancre, duration; Position; glandular, urethral, coronal, or frænal—external, internal, or fringing preputial; character, indurated, non-indurated, aphthous, raised, excavated, irritable, phagedænic, or sloughing; tubercle; condition of inguinal glands, indurated or inflamed. *Previous Treatment*, particularly as regards mercury.

COMPLICATIONS.—Note the date of appearance, and situation of each or any of the complications; the order and time of their occurrence after the primary sore. Present appearance and Treatment of each.

GONORRHŒA.—Date of contraction; former treatment, especially as regards injections, copaiba, &c. Complications, and their duration; in epididymitis, if following suppressed discharge; use of injections, copaiba, or violent exercise.

STONE IN BLADDER.—When discovered; date of earliest symptoms; if preceded by the passage of sand; amount of irritability of bladder; character of urine; constitutional and local symptoms. Treatment—Lithotrity or Lithotomy; in latter, note any peculiarity; date of arrest of the flow of urine through the wound.

TUMOURS.—Date of its discovery and size; rapidity of growth; general and local symptoms, in their order of appearance. General health, prior to discovery, and since; hereditary tendency; assigned cause; depressing influences. In Mammary Tumours, number of children; date of birth of last; if ever suckled with affected breast, when; condition of the catamenia, if ceased, how long? Previous Treatment, and success.

PRESENT CONDITION AND APPEARANCES.—Position of tumour; size, shape; external aspect and condition of skin; Pain, and its character; condition of lymphatic glands; manipular indications; mobility, when in breast, whether moved by traction of the nipple; Feel, hard, elastic, &c., &c. Constitutional symptoms.

TREATMENT.—In recurrent growths, give the date of former operations; date when healed; and of its first reappearance, and position.

OPERATIONS.—Describe position, direction, and number of external incisions; the steps of the operation as performed; its duration; number of vessels tied or twisted, and amount of hæmorrhage. In Amputations, the part amputated, and position of amputation. In Flap operations, give the position of the flaps; whether anterior, posterior, or lateral; whether performed by perforation or external incision. In the combined flap and circular, note the position of the skin flaps; in all, note the result and character of stump.

CHAPTER I.

ON REPAIR AND INFLAMMATION.

THE repair of wounds after injury is a subject of so much importance that I have thought it well to devote an early chapter to its consideration; for, as in practice, the surgeon's aim is to place wounded parts, whether hard or soft, in the most favorable position for repair, and to remove all obstacles that are likely to interfere with the natural evolution of the process; so is it incumbent upon him to know how nature proceeds in carrying ont her end, in order that he may in no way by acts of omission or commission interrnpt the performance of that desirable object.

Identity of repair in all tissues.

Before entering into details, it is also well to know, as a primary truth, that the processes of repair are identical in all tissues; that the reparative process in bone or muscle, integument or tendon, soft or hard parts, is the same, such modifications alone showing themselves as necessarily appertain to the anatomy of the tissue or special circumstance of its position. Thus, tissues that are highly vascular may undergo more rapid and more perfect repair than others less fortunately circumstanced, and bone tissues may require more time to unite than skin, yet in all the process is alike. Let us therefore enquire what the process is, and see what changes take place in parts undergoing repair; and then look at them where they are best seen, when an incision is made through the skin and the edges are brought together.

Reparative process.

Example, skin.

The chief points that can be observed have reference to the capillaries. In these, at the margin of the wound, the blood will be found coagulated up to the nearest anastomosis, and the capillary vessels in the neighbourhood will be seen dilated—this dilatation being caused by the increase of pressure to which the capillaries have been subjected by the altered circulation of the blood in the immediate vicinity of the wonnd. When wounds unite by *immediate union* no other changes than these take place, beyond the gradual restoration of the capillary circulation through the parts that have been divided, and under these somewhat rare circumstances no scar or cicatrix is left. The soft parts at first simply adhere together, and consequently become continnous.

a. Immediate union.

Should the wonnd unite by what is called *adhesive union* or *primary adhesion* (the "first intention" of John Hunter), in which a cicatrix is formed, other changes are to be seen; and these take place in the connective tissue—in which the vessels of the part ramify—a tissue that pervades every other, and which is made up of cell elements and intercellular tissue, the cell elements varying according to the nature of the part in which it is fonnd.

b. Adhesive union.

Cell development.

These changes consist of cell multiplication, and, under the circumstances supposed, we find between the edges of the wound a vast accumulation of cells, filling up in various degrees the spaces of this wounded tissue, and, through these cells cicatrisation takes place.

Whether this cell multiplication depends upon changes in the cell

itself, as Virchow affirms, or whether the cells are the white corpuscles of the blood which have escaped by exudation from the capillaries, as Cohnheim would lead us to believe, I do not now care to inquire. All admit, however, the multiplication of cells in the affected tissues (*vide* fig. 1). Professor Redfern writes (address at British Association, 1874), "the facts must be recognised; the floating blood-cells are really the very cells which once formed the substance of the lymphatic glands, the spleen, and other organs; and they do, in fact, move through the walls of the blood passages, and wander about freely in what are called solid tissues." When we recollect how penetrable the tissues of an animal are, we shall cease to be startled at seeing those parts become the seat of entirely new deposits, or finding them traversed by migrating blood-corpuscles as freely as a colloid is penetrated by a crystalloid.

Formation of connective tissue.

Let us now inquire briefly how cicatrisation proceeds, and note that it is in the cells that the most important changes are to be recognised. Those nearest the injured part gradually assume a spindle shape, and the intercellular tissue into which these spindle-shaped cells are infiltrated becomes denser. The spindle-shaped cells then gradually change into ordinary connective-tissue corpuscles, and in this way new cicatricial tissue is formed. This new tissue, however, again undergoes changes—changes of consolidation. The intercellular tissue becomes gradually more condensed — the spindle shaped cells also assuming the flat shape of connective-tissue corpuscles, and in a measure disappearing, the nucleus often alone remaining—the fluid that existed in the newly formed tissue is absorbed, and the new cicatrix by degrees thus becomes firmer and denser, gradually contracting, so that at last the delicate scar of a large wound becomes solid and compact—the cicatrix in smaller wounds appearing only as a thin red, and at a later period as a white line.

Changes in capillaries.

Changes in the capillaries of the part are, however, going on during all this period, and how far *all* the changes that have been briefly described are due directly to the capillary action is not yet determined. If Cohnheim's views be adopted, it is to the capillaries that the chief action in the tissues must be ascribed. According to those of pathologists, such as Virchow and Billroth, the capillary action takes a secondary place, the cell elements the leading one. But on either theory the importance of the capillaries cannot be overlooked.

With regard to the changes in the capillaries, it has been already pointed out how at the beginning of the reparative process those of the part become sealed, and the collateral circulation in the neighbourhood becomes irregular and pressed upon; and how the coagula in these obliterated capillaries become reabsorbed or possibly reorganised as repair progresses. It is certain that the capillary network soon becomes continuous through the newly formed cicatricial tissue, the capillary meshes of the one side joining, by loops projected through the new tissue, the same meshes of the opposite one.

Influence of nerve on reparation.

What influence the nerves of the part have upon the reparative process we do not know. That they have an important influence there can be little doubt, since all physiologists recognise their power upon secretion and nutrition; the vaso-motor nerves doubtless have the greater power. But we must learn something more of nerve power generally and nerve distribution—something of the way in which the

Diagram illustrating the process of repair in a wound filling up by granulation.

(This drawing has been made for me by my friend, Mr. Howse, from microscopical sections of granulation in his possession.)

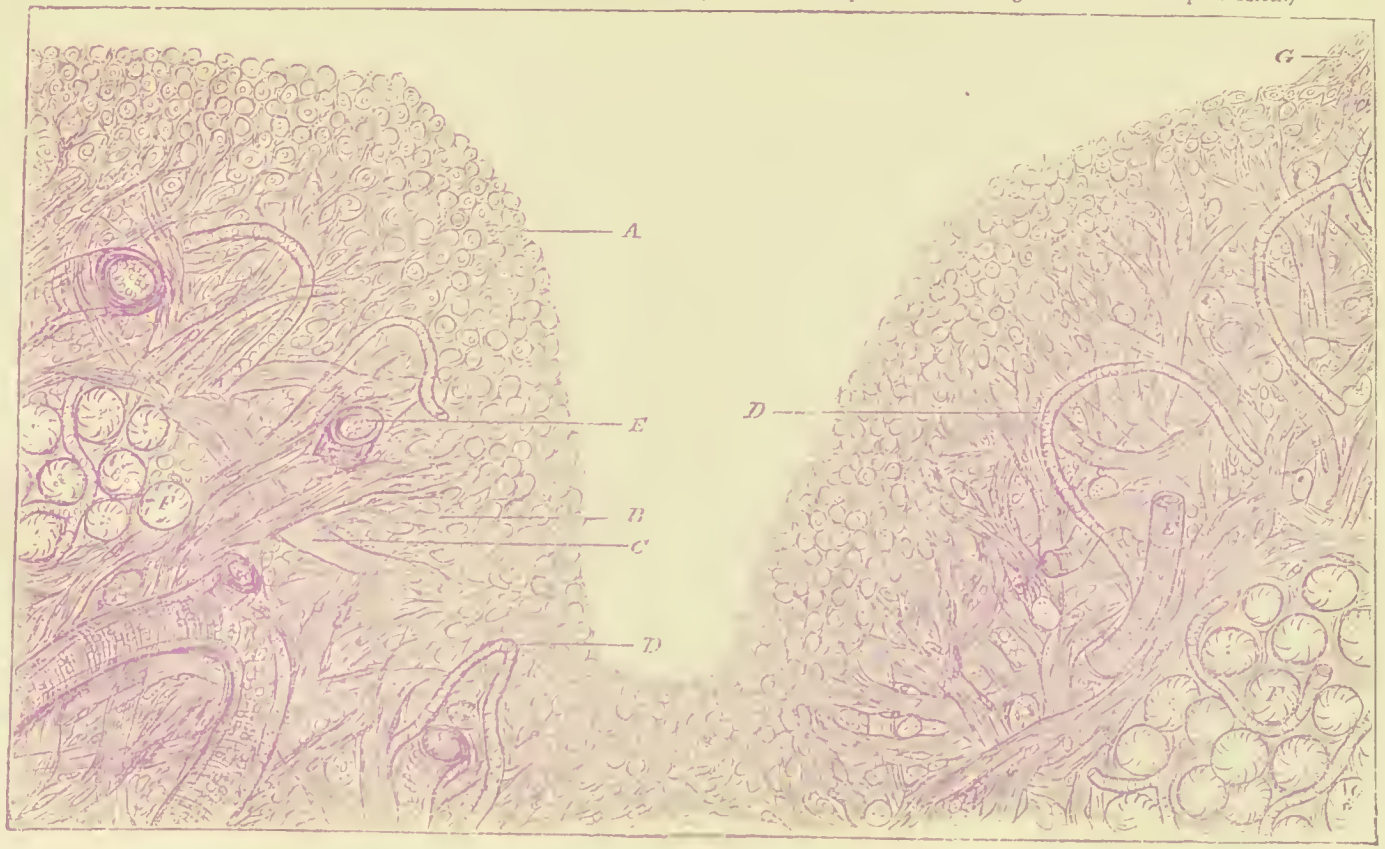


FIG. 1.

A=Granulation-cells with single or double nuclei. These, when shed, are pus-cells. *B*=The same cells becoming spindle-shaped. *C*=Intercellular element becoming developed into bundles of white fibrous tissue. *D*=Capillaries. *E*=Small arteries. *F*=Fat-vesicles forming lobules. The two last structures constitute part of the original subcutaneous tissue. *G*=Superficial cells becoming converted into epidermal scales.

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nerves terminate in the tissues, and what relation they bear to the capillaries—before we can hope to find out or understand the exact influence nerve supply has on repair.

c. Repair by granulation.

All wounds do not, however, heal by immediate union, or by primary adhesion, *i.e.* first intention, and wounds that gape cannot so unite. The process of repair in these, therefore, differs somewhat in its character from those we have been considering; it *takes place by granulation*, or the "second intention" of Hunter. If we closely examine the surface of a wound thus exposed, we shall find that it becomes within a few hours of its exposure covered with a film of a peculiar gelatinous, greyish-white appearance. This will be seen with the aid of the microscope to be composed of granulation-cells or white blood-cells. If the edges of the wound are then brought together, union may take place, this form of healing being termed *secondary adhesion*. After an interval of some hours the parts covered with this gelatinous greyish film become more vascular, as indicated by redness, and the surface more even. The film itself assumes a tougher character, and a yellow fluid, which is mixed with small yellow sloughs of fibrinous tissue, is secreted. The wound begins "to clean," and to have a smooth and consistent surface. After the lapse of another day, or some days, perhaps, this surface is covered with a number of elevations, known by the name of *granulations*, varying in size from a millet-seed to a hemp-seed, the smaller being highly vascular and red, the larger being, as a rule, paler and more bloodless. The wound at this time is "granulating." The secretion from these granulations is now of a creamy-yellow character, and is called *pus*. They are made up of cells called granulation cells and resemble inflammatory lymph-cells. Each granulation contains a vessel, the walls of which consist of a thin membrane, in which nuclei are embedded. "Some of these nuclei are arranged longitudinally, others transversely to the axis of the vessels. In the development of these vessels changes occur, answering to those seen in ordinary embryonic development. Organisation makes some progress before blood comes to the very substance of the growing part; for the form of cells may be assumed before the granulations become vascular. But for their continuous active growth and development fresh material from blood, and that brought close to them, is essential. For this the blood-vessels are formed, and their size and number appear always proportionate to the volume and rapidity of life of the granulations. No instance would show better the relation of blood to an actively growing or developing part than in one of the vascular loops of a granulation embedded among the crowd of living cells, and maintaining their continual mutations. Nor is it in any case plainer than in that of granulations that the supply of food in a part is proportionate to the activity of its changes, and not to its mere structural development. The vascular loops lie embedded among the simplest primary cells, or when granulations degenerate among structures of yet lower organisation; and as the structures are developed, and connective tissue formed, so the blood-vessels become less numerous till the whole of the new material assumes the paleness and low vascularity of a common scar." (Paget.)

Development of granulations.

Secretes pus.

Section of granulation.

Their vascularisation.

If, at this time, when the granulations have attained to the level of the skin, we look to the margins of the wound, we shall see a dry red band of newly formed tissue, with an outer border of a bluish-white

Formation of new skin.

colour, where it comes into contact with sound integument. This band is the new skin forming, and is caused by the gradual growth of the epidermis from the margin of the sound skin towards the centre of the sore. Such a process is called *cicatrisation*. The cicatrix is at first red, as in the linear cicatrix to which we have already alluded, but, as it then contracts, subsequently it becomes paler, more compact and adherent. The nature of the scar or cicatrix varies with the tissue in which it is formed, the new connecting medium or cicatrix under all circumstances having a powerful tendency to adapt itself to the peculiar character of the tissue in which it is placed. Thus, a cicatrix in skin in time closely resembles true skin, a cicatrix in bone true bone, and in a tendon it becomes tough and hard, like tendon; the consolidating reparative material in every instance partakes of the character of the parts which it connects. It is corpuscular in its origin, and clearly fibrinous in its nature; but whatever the origin may be (though there is considerable divergence of opinion about it), its existence is undoubted, and through it and by it all repair takes place.

d. Repair by scabbing.

When wounds *heal by scabbing*, granulations do not form. In this process the reparative material which is poured out undergoes at once similar changes to those already described as taking place in adhesive union, and the wound cicatrises rapidly beneath the scab; for the serum of the blood when effused on the surface of a wound is of a highly plastic character, and rapidly coagulates to form a film of a protective nature, under which repair may rapidly proceed. Advantage is taken of this fact in the treatment of superficial wounds; the value of felt, cotton wool, or any similar material, when applied to an open wound, entirely depending upon this plastic property of blood. Repair by scabbing is doubtless the best form of healing, although it is, unfortunately, somewhat rarely obtained.

The *healing of subcutaneous wounds* must be somewhat similar. Some details of this process will be given in the chapter on Tendons.

Causes of non-repair.

I propose now to consider some of *the causes that interfere with repair*, amongst the most frequent of which I would place hæmorrhage. Blood, if effused to any extent between the edges of a wound, greatly interferes with the reparative process, and not only forbids all healing by immediate union, but interferes with healing by primary adhesion. If effused in very small quantities between the divided surfaces, it may at times possibly change into cicatricial tissue, and form a bond of union between the divided parts, and in certain other instances it may organise, as on the brain; but if effused to any great extent it will, in all probability, eventually break up and act as a foreign body, causing irritation and inflammation.

If *foreign bodies* exist between the edges of a wound, union cannot go on.

If *the wounded parts are much contused*, union can only take place by granulation or secondary adhesion.

If *the edges of a wound are allowed to gape*, or have too much tension upon them, the same observations apply.

If *the injured parts are not kept quiet*, repair cannot go on, as is well exemplified in fractures.

If *too little action* is present from deficiency of power, as is seen in the very old and the very young, in plastic operations and the non-

union of fractures, &c., nnion cannot take place; and a like resnlt ensues when *too much action* exists.

This leads me now to consider what too mnch action in a wonnd means; how it is to be recognised clinically and pathologically; and what are its results.

It is commonly known by the term *inflammation*; and as this process, whether it affects a wound or any other part, has the same symptoms, I shall speak of it generally. As it affects a wonnd, so it affects the tissues when uuattended by a wonnd; consequently the consideration of its phenomena in the one case will illustrate the other. Inflammation.

The Phenomena of Inflammation.

When *a wound is inflamed* there are four points that arrest attention. The first is *redness*, which appears as a mere blush on the edges of the wound, or may extend far and wide all aronnd. It is either of a bright red colour or of a livid hne—the former tint indicating a healthy or *sthenic*, the latter (evidencing want of power), an *asthenic inflammation*. The redness is donhtless dne to the capillary injection of the part; and, as we have already seen that in the repair of wounds capillary injection is a necessary attendant, so the redness of inflammation in a wonnd is simply the result of this carried to excess. *a.* Redness.

The second is clearly connected with the first, indeed, it may be regarded as a result. It is *increase of heat in the part*; increase of action, as indicated by excess of vascularity, being generally accompanied by this symptom. There is reason too for believing that the blood is also overheated. The third is also striking, and is clearly a result of the capillary injection, to which notice has just been drawn. It is the *swelling of the inflamed part*, which shows itself either as a simple œdema of the edges of the wound, or as a more or less general, diffnsed infiltration of the parts. This swelling is apparently due to blood stasis, and is produced by the passive exudation of the serum of the blood into the cellular tissne of the inflamed part, from the stagnation of the blood in the overloaded capillaries of the injnred tissne. *b.* Increase of heat. *c.* Swelling.

The fourth is *pain*, which symptom varies much as to its intensity, and apparently depends a great deal npon the amount of swelling and tension in the inflamed part. In inflammation of the bone, periosteum, or any nnresisting fibrous tissue, as the coat of the testis or the sclerotic of the eye, the pain is intense; in rheumatism in which the fibrous structures of the joints are inflamed it is also marked. Probably it is caused by direct pressnre on the extremities of the nerves of the swollen tissue. It may be simply an increase of sensibility of the part or may amount to severe agony. *d.* Pain.

We thus have *redness*, *heat*, *swelling*, and *pain*, as symptoms of overaction of a part, or of what is called *inflammation*, and they, one and all, appear to be direct consequences of extreme capillary vascularity of the tissue, whether that be the result of a wonnd or not. They may manifest themselves in every degree of severity, their extent depending npon the intensity of the inflammatory action and the nature of the tissues that are involved. When a loose tissue is involved, the redness will be much marked, and the swelling will probably be rapid, but the pain will certainly be slight, as the tension of the part is rarely severe. When the connective tissne situated beneath a dense fascia or skin is involved,

the redness and the swelling are, as a rule, but slight, since the peculiarities of the part affected prevent their being manifested; but the pain will probably be severe, for the tension of the tissues, and the pressure upon the nerves of the part will, under such circumstances, be necessarily great.

When the inflammation is *acute* or rapid, all these symptoms manifest themselves with great rapidity, and the results of the action are quickly shown; when it is slow or *chronic*, they are less clearly marked.

Inflammatory fever.

With these local symptoms of inflammation there will always be associated some *disturbance of the function of the inflamed part*, or probably its arrest; and what is of equal importance, some constitutional disturbance, which is known as *inflammatory fever*. This fever may manifest itself in all degrees of severity, its intensity depending much upon the character of the inflammation and its seat. When a local affection is *acute*, or of a *sthenic* nature, the constitutional disturbance will be severe; when *chronic* it will probably be mild; and when *asthenic* it will be marked by great depression. It may show itself, therefore, only as a slight febrile state, or it may be marked by the severest symptoms.

The following description may be accepted as a type of the affection. I have taken it from Simon's masterly article in Holmes's 'System of Surgery,' 2nd edition, vol. i, p. 21:

Symptoms, example, compound fracture.

"Taking, for instance, a case of severe compound fracture, without much hæmorrhage, in a person otherwise sound and strong, we find that, before twenty-four hours have elapsed from the time of injury, his general system begins to be thus affected. He feels hot, or alternately very hot and chilly. His skin and lips and mouth are dry. He passes urine in less quantity, but of a higher colour, than usual. His pulse is quickened. A sense of general disorder gains upon him. He becomes restless and intolerant of disturbance. Signs of drought increase with him. His urine becomes scantier and more coloured. His skin feels hotter to the Surgeon's hand, and his pulse, whether full or hard, is quicker and stronger than before. He craves more and more for water. His face has a flushed, anxious look. He is thoroughly uncomfortable; for the most part feeling distressingly hot, but at irregular intervals feeling touches of chilliness—sometimes even of such cold that he shivers with it. His sleep is troubled and unrefreshing; or, as night comes on, he gets delirious. His tongue, besides being dry, is furred. If his bowels act (which commonly they are inapt to do without laxatives) the excretions are morbidly offensive. Gradually these symptoms give way; in proportion as the injured limb ceases to be tense, and passes into suppuration, the skin and mouth become moist again; the excretions lose their concentrated character; the hard pulse softens, and the heart's action becomes quiet; the nervous system is no longer restless; the look of trouble passes from the countenance, and the patient can again take solid food."

Causes.

There can be little doubt that these symptoms are clearly due to an increase in the temperature of the blood, and that their severity is measured by it. This is, indeed, as Simon has so aptly expressed it, "the essential fact of inflammatory fever. It is to this fact that the familiar language of feverishness bears witness,—the thirst, the scanty urine, the heat, and the shivering, the troubled brain, the excited circulation. As the blood gets hotter and hotter, more and more do these symptoms

become developed. As the blood subsequently gets cooler, so, more and more, do they decline."

Average temperature.

The average temperature of the healthy human body according to Jürgensen (Leipsig, 1873) is 98·9° F. or 37·2° C., but the range between, 97 and 99, is quite consistent with health. A febrile condition arises from an increase of temperature accompanied by more or less constitutional disturbance.

Excess of temperature.

It seems from Dr. Montgomery's observations, made for Mr. Simon, that "febrile excesses of bodily temperature range perhaps to ten degrees above the normal heat of the blood; the 'crisis' of a febrile state consists in a rapid and generally continuous reduction, the 'lysis' in a slow and generally discontinuous reduction, of this abnormal temperature." With respect to the causes of this greater heat of blood, it is probable that the fever originates in the tissues themselves, and is a disorder of protoplasm; the results of inquiry showing "that either continuously during the intensity of feverishness, or else more abruptly when feverishness begins to subside, there can commonly be traced in the excretions an excess, more or less considerable, of those nitrogenous, sulphurised and phosphorised products which emanate from textural and humoral waste; that this increased elimination is observed even when ingestion has been reduced to a minimum; and that febrile excretions do, therefore, as a rule, undoubtedly attest an increased devitalisation of bodily material." The febrile process is then clearly a disorder of nutrition, in which in man the exchange of nitrogen exceeds the normal expenditure by nearly three quarters, and in which there is likewise an excessive discharge of carbonic acid. The discharge of nitrogen is evidently due to the disintegration of tissue or possibly of blood. This fact explains the rapid waste of body which takes place in fever. The blood coagulates with what is generally described as a "buffy coat," and it seems highly probable that, under these circumstances, it contains more than its normal complement of fibrin. There is good reason also to believe that this "buffy coat" is due to the fact that the blood-corpuscles subside in the liquor sanguinis during coagulation, leaving the upper portion of the clot colourless. What this increase of fibrin in the blood in inflammation means is a question that remains to be decided. Some pathologists believe that the blood is excellent in proportion as it is fibriniferous; that solidifying fibrin is almost incipient tissue; that the fibrinous crust, as drawn in inflammation, is the sign of its being specially adapted to the purpose of additional growth; while Simon, with others, holds "that the blood yields more fibrin, not in proportion as it is ripe and perfect, but rather in proportion to quite opposite conditions; that an increased yield of fibrin portrays not perfection, but post perfection in the blood; that it corresponds not to the rise, but to the decline of albuminous material; that the relations are not with repair, but with waste; that its significance is that of something intermediate between life and excretion; that the fibriniferousness of the blood is undiminished, probably even increased by bleeding; that it is greatly developed during starvation, during violent fatigue, during diseases essentially anæmic; that its increase, under these circumstances of exhaustion, weakness and inanition, is to the full as great as its increase during inflammation."

Its causes.

Excess of fibrin.

"These latter views seem to be most in accord with truth and with

the general chemistry of inflammatory fever. They seem to indicate that the fibriniferousness of the blood in inflammation represents action of devitalisation and decay in some albumiuous material. Whether this changing material be the inflamed texture gradually dissolving itself into the blood, or he the albumen of the fevered blood itself undergoing accelerated waste, cannot in the present state of knowledge be even approximately stated." (Simon.)

With this brief description of the phenomena of inflammation and inflammatory fever, I propose next to consider the effects *of inflammation*, or exeess of action, on a given part.

The Effects of Inflammation on a Part.

Effects of excess of inflammation.

When inflammation attacks a wound, or excess of action exists in it, repair is interfered with, retarded, or destroyed, in proportion to the intensity of the inflammation; because anything like inflammation of the part is fatal to the immediate union of a wound, as it is to healing either by scabbing or secondary adhesion. In primary adhesion and in healing by granulation, an inflammation sufficient to lead to the pouring out of plastic reparative matter (the granulation tissue of Virchow, embryonic tissue of Rindfleisch) is not injurious; but it must not go beyond this point.

Arrest of repair.

When acute inflammation attacks a wound either of the soft parts or of bone, there is an end to all repair, and partial union may be changed into complete disunion, or the inflamed tissue may wholly or in part die. When soft tissues die in mass they are said to *mortify;* when this action is spreading it is called *gangrene*, or *sloughing phagedæna;* and the dead part thrown off is known as a *slough*. The death of bone is called "*necrosis*," and the dead piece of bone a "*sequestrum*." When a portion of tissue dies, the dead is separated from the living piece by a process known as that of *ulceration;* when the ulceration spreads, an *ulcer* is said to exist; when this undergoes repair, it does so by *granulation*. Ulceration of a part means its molecular death.

Asthenic inflammation.

There is, however, a low or asthenic form of inflammation found in subjects of feeble and depressed powers which differs in a measure from that which we have been considering. It usually comes on at some late period of the healing process, and manifests itself by clinical phenomena of a subdued character. Redness will be present, although it will not be of a vivid, but of a dull and dusky character; swelling, too, will exist, but it will be of an œdematous kind; the pain will be dull, and the discharge serous or sero-purulent. It affects repair as injuriously as the more sthenic form.

Such, then, are the chief local effects of inflammation on a wound; but there are others of no little importance to which attention must be drawn, the principal one referring to inflammatory exudation into a part.

Swelling and its varieties.

We have already stated that when inflammation attacks a tissue, swelling is one of the chief clinical signs, and this, without doubt, is directly caused by effusion. The character of this effusion also varies with the activity, character, or specific nature of the inflammation. When the inflammation is of a healthy or *sthenic* kind, it will tend towards the fibrinous variety, producing plastic infiltration of the part;

when of a feeble or *asthenic* form, the serous and corpuscular elements will predominate. In the former the soft tissues will appear firm and dense, and in the latter soft and œdematous.

In healthy subjects this plastic material may be re-absorbed, and the tissue into which it had been infiltrated left perfectly sound—recovery then taking place by what is termed *resolution*; in exceptional instances it may become organised. In unhealthy subjects the infiltrating material may break up or degenerate, and give rise to what we know as *pus*. When this forms in a part, *suppuration* is said to have taken place. Inflammatory lymph may consequently be converted into pus. Sir J. Paget has pointed out how, in amputating through a limb infiltrated with lymph, pus may flow from the wound in the course of a day, while it is known that in amputation through healthy tissue free suppuration does not usually appear till after three or four days. Under these circumstances the pus must have been formed by the conversion of the inflammatory lymph previously infiltrated into the divided tissues. Resolution. Suppuration.

"When an inflamed part is cut, the first pus is from lymph; the latter pus—when repair is in progress—from granulation substance. In both cases alike the pus manifests itself as a rudimental substance, ill-developed or degenerated; and the transition from one condition to the other is an evidence of the impossibility of exactly defining between the inflammatory and reparative processes, unless we can see their design and end." "From these and like facts," says Paget, "we have an almost exact parallel, in their relation to pus, between the material for repair by granulation and that produced in the inflammatory process, and between, if they may be so called, the reparative and the inflammatory suppuration."

Dr. Burdon Sanderson's investigations, as given in 'Holmes's System,' have led him to regard inflammation as due to excessive irritation of the tissues, this irritation setting up, 1st, disorder of the circulation; 2nd, transudation of blood constituents; and, 3rd, alteration in the nutrition of the inflamed parts. Sanderson's views.

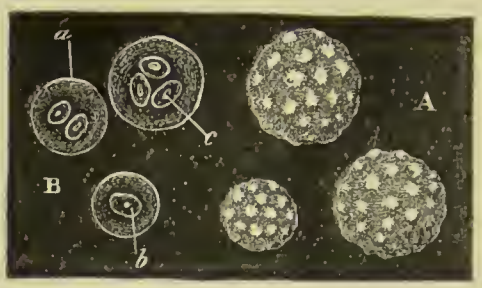
Stasis of blood in the inflamed parts is the first effect of inflammation; this stasis, which is attended by the crowding together of the white corpuscles or leucocytes, being followed by their motion, their subsequent passage through the capillary walls, and their accumulation in the tissues. The serum that exudes with the leucocytes gives rise to swelling, the leucocytes themselves forming the first purulent elements in the tissues. Cohnheim, indeed, considers these leucocytes as the sole source of purulent infiltration; but the facts before given fairly show that this cannot be the case, pus being probably a compound fluid of leucocytes and degenerated inflammatory tissue.

Pus itself is made up of a thin transparent fluid and pus-corpuscles. These corpuscles are globular, and larger than the white corpuscles of the blood. They are minutely dotted, and contain three or four small dark nuclei which become clear by the addition of acetic acid, and nucleoli (*vide* fig. 2). Acetic acid dissolves the nucleus of a white blood-corpuscle. Pus.

Pus is also soluble in alkalies, and has an alkaline reaction. It contains from fourteen to sixteen per cent. of solids—chloride of sodium and phosphates. Dr. Day, of Geelong, has given us a new test for pus that is worthy of record. He prepared his test-fluid by exposing a

saturated alcoholic solution of guaiacum to the air until it had absorbed a sufficient quantity of oxygen to give it the property of turning green when placed in contact with iodide of potassium. On moisten-

Fig. 2.



A. Pus-corpuscles (magnified 350 diameters). B. Same made transparent with acetic acid. *a*. Cell-wall. *b*. Nucleus. *c*. Nucleolus. (After Lebert.)

ing the smallest quantity of pus with water, and pouring a drop or two of the test-fluid over it, a clear blue colour was produced.

By means of this test he has made out that healthy pus, when dried, becomes chemically inactive, and non-susceptible to the test, although when moistened with water it resumes its chemical activity; whilst pus taken from an erysipelatous, carbuncular, or pyæmic patient, retains for many months, although dry, its chemical activity, and responds to the test at once. He believes, consequently, that a moist atmosphere promotes and that a dry retards the spread of erysipelas and allied affections. He finds that carbolic acid destroys for ever the chemical activity of all pus-cells. ('Med. Times,' March 11, 1871.)

The investigations of M. Schultze have proved that pus when seen in a moist chamber and on a warm stage exhibits very beautifully the amœboid movements; whilst those of Recklinghausen seem to indicate that the globular appearance of the pus-cell is indicative of the death of the cell.

ABSCESS.

On abscess.

Whatever may be the origin of pus, whether degenerated lymph, or a new cell growth the result of inflammation of areolar tissue, or escaped white blood-corpuscles, a *circumscribed* collection of pus in any tissue is called an "*abscess*;" and when pus is not circumscribed but *infiltrates* a part, *diffused suppuration* is said to exist, this latter condition always indicating want of power.

Varieties.

An abscess that forms rapidly and is associated with severe inflammatory symptoms is known as an "*acute abscess*;" that which is the result of a chronic action and of slow formation, as "*chronic or cold abscess*." There are, moreover, many intermediate forms.

Pus may be absorbed.

Pus may, however, be absorbed, the serous fluid in which the cells float being taken up, and the cells left to wither—these subsequently forming a pultaceous, and, at a later date, a cretaceous mass. Clinically, however, pus may disappear altogether, and leave no external evidence of its former existence. The fact is now clearly

recognised by surgeons; and the absorption of pus is constantly seen in the eye in hypopyon as well as in the disappearance of periosteal enlargements, and chronic subcutaneous abscesses.

Varieties of pus.

Pus varies much in its character; when thick and creamy, it is known as healthy or *laudable* pus; when thin and watery, and containing ill-formed pus-cells, it is called "puriform fluid," this condition being generally indicative of want of power; when it is blood-stained it is called "sanious;" when thin and acrid "ichorous;" and when it contains flakes of curdy lymph "curdy." Pus from the interior of a bone is oily, containing, as Bransby Cooper showed, granular phosphate of lime. Sir D. Gibb has collected sufficient evidence to prove that the presence of cyanurate of iron may give to pus a bluish tint, while that from the brain is often green, from the liver brown; the *débris* of broken-down tissue in different proportions and of different kinds giving these appearances.

Walls of an abscess.

The walls of an abscess are due to the organisation of the inflammatory products, whereby nature checks the extension of the disease, and forms what surgeons of old called the "pyogenic" membrane; around the walls the parts are always œdematous from serous effusion, as indicated by pitting on pressure.

On acute abscess.

An acute abscess comes on with fever and severe constitutional disturbance, accompanied by the usual local phenomena of inflammation, such as pain, redness, heat, and swelling. As the abscess forms, the local symptoms become intensified, and perhaps concentrated; the pain also alters in character, becoming at first dull and heavy, and then throbbing; the fever symptoms also subside, or rather intermit, a shivering fit or rigor more or less well marked, followed by heat, and possibly sweating, taking its place. The swelling, moreover, which was previously diffused becomes more localised; the parts covering it begin to thin, and with the fingers of one hand steadily kept flat upon the swelling, and those of the other made to press upon it in another part, the walls of the abscess will be made to bulge against the fixed fingers, and a sense of "fluctuation" be given—this feeling of fluctuation indicates the presence of fluid, and in this particular case of pus. Under these circumstances the "pointing" of the abscess will soon take place, and if the case be left to nature, the thinning of the part covering in the abscess will continue in the direction of least resistance; the skin when involved will either slough, or ulcerate, and the abscess burst, discharging its contents. The pus having now been evacuated, the walls of the abscess by their natural elasticity will fall together or collapse, the external wound close, and the whole heal or contract into a *sinus* or narrow canal, sometimes called a *fistula*. When, however, the pus is *deep-seated*, bound down by fascia or periosteum, what is called "*burrowing*" takes place; the matter makes its way between the soft parts, where the least resistance is met with, and opens either into a mucous passage, serous cavity, or joint. Abscesses beneath the periosteum constantly open into joints; those beneath the abdominal muscles or within the abdomen, into the intestinal canal; and others in the extremities may burrow beneath the muscles, and make their way to the surface a long way from the original seat of the disease. In disease of the dorsal vertebræ an abscess may burrow beneath the abdominal fascia, and extend behind the sheath of the psoas muscle, Poupart's ligament, and deep fascia of the thigh, and open on the inside or outside of the thigh; whilst

Local signs.

Fluctuation.

Burrowing abscess.

Examples of burrowing abscess.

in other cases it may pass into the pelvis, and out again at the sciatic notch; and appear in the buttock as a "gluteal abscess." In disease of the lumbar vertebræ an abscess may also form, burrow between the abdominal muscles and appear in front of the abdomen above Poupart's ligament. An abscess beneath the scalp may undermine the whole scalp tissue; one behind the fascia and muscles of the pharynx may spread so as to cause a large post-pharyngeal tumour, and cause death by suffocation; while deep-seated abscesses of the neck may burrow into the thorax, and thus produce fatal mischief. These instances serve to show how pus, when confined beneath a strong membrane, will burrow along the cellular tissue of a part to find some outlet, and how necessary it is for the surgeon to be aware of the fact, in order that he may stop the process, or trace the cause of the disease to its source.

Acute abscess in bone.

Acute abscess in bone is attended with severe local symptoms and constitutional distress, but to this subject attention will be drawn in a later page (chap. xxxiii).

On chronic abscess.

Some *chronic abscesses* are of remarkably slow formation and give rise to very little constitutional disturbance or local distress; indeed, except mechanically, they seem to be of little annoyance unless they are secondary to some organic disease. Even then it is astonishing to what a size a chronic abscess will sometimes attain before it is discovered or complained of. In spinal cases this is often verified. In children, also, large abscesses form in the same quiet way. They are, however, never met with in the robust and strong. Abscesses connected with enlarged glands are peculiarly passive in their progress, and appear to cause pain only when they begin to make their way through the skin. Those, again, which appear during the convalescing period of joint disease when the disease seems to be undergoing recovery, show themselves in the same quiet way. They seem to be a simple breaking-down of old inflammatory products poured out in the cellular tissue during the more active period of the disease, and which had failed to be re-absorbed or to become organised. Constantly they undergo absorption, and should not rashly be interfered with.

Treatment of abscess.

TREATMENT.—During the formation of an abscess, fomentations, poultices, and warm-water dressings give comfort, and may be used. They are only admissible, however, when suppuration and external discharge may be expected. When absorption is probable, such means should not be employed. This result, however, can only be expected in chronic abscesses which are not connected with deep-seated mischief. The local affection requires, therefore, no other treatment than rest and an absence of all irritating applications; tonic treatment and regimen being the chief means upon which reliance can be placed.

Use of aspirator.

On some occasions I have drawn off the pus from a chronic abscess with the aspirator, and no re-collection has taken place, but as often as not the fluid re-accumulated, and a free incision was subsequently necessary. Whenever an abscess is opened the incision should be free enough to admit of a ready outlet of its contents, and to prevent any re-accumulation.

Treatment of abscess.

Wherever burrowing suppuration in a part can be detected, the sooner an external outlet is made the better, whether that burrowing be beneath the scalp, behind the pharynx, among the deep cervical tissues, in the thecæ of tendons, between the layers of muscles of an

extremity, or beneath the periosteum of bones—specially about joints or anywhere beneath the deep fascia, and particularly the fasciæ of the perinæum and anus.

Superficial abscesses ought always to be opened, and a lancet, or a fine double-edged knife with a central groove, should be employed (fig. 3). By incision.

Fig. 3.



Double-edged Abscess Knife, with groove in centre.

On the neck and face the line of incision should be made to correspond with the course of the superficial skin muscles, or the lines or folds of the part—the deformity resulting from the cicatrix being thereby greatly diminished; but in other cases the incision must be in the best direction for emptying the cavity. In all abscesses the puncture should be made where the abscess is "pointing," or the integument is thinnest; and, where this indication is absent, at the most dependent part of the abscess. The operator should always avoid dividing superficial veins and nerves, the position of the former being made out by intercepting the flow of blood through them by the pressure of the finger. Deep vessels and nerves should be carefully avoided, their anatomical position being always remembered. When abscesses have to be opened in their neighbourhood, the incision should be made parallel to them. Avoid deep vessels.

In opening an abscess a plunge ought not to be made. The operator should mark the point of intended puncture with his eye, then, introducing his instrument with decision through the soft parts into the cavity, make the incision of the required length by cutting outwards as soon as pus oozes upwards by the sides of the instrument. To do this sleepily is to give unnecessary pain, whereas to do it with a stab or plunge only causes unnecessary alarm. It should be done, as ought every other act of surgery, with confidence and decision; boldness and rapidity of action being governed by caution, and made subservient to safety. Mode of opening abscesses.

To open an abscess that is pointing (or which has a cavity to be felt) by dissecting down upon it, is a *bad* practice; although in deep-seated abscesses, which are covered by parts which it would be dangerous to wound, where surgical interference is called for, such a method may be the best—extreme caution being requisite under extreme danger. Under these circumstances the surgeon should follow Mr. Hilton's method of opening deep-seated abscesses, which has been practised at Guy's for many years.

In deep-seated abscesses in the axilla, says Hilton ('Lectures on Rest,' 1863), "I cut with a lancet through the skin and cellular tissue of the axilla, about half or three quarters of an inch behind the axillary edge of the great pectoral muscle. At this point we can meet with no blood-vessels. Then I push a grooved probe, or grooved director, upwards into the swelling in the axilla; and, if you watch the groove, a little opaque serum or pus will show itself. Take a blunt (not a sharp) instrument, such as a pair of dressing forceps, and run the closed blades Hilton's method.

along the groove in the probe or director into the swelling. Now, opening the handles, you at the same time open the blades, situated within the abscess, and so tear open the abscess. Lastly, by keeping open the blades of the forceps during the withdrawal of the instrument, you leave a lacerated tract or canal communicating with the collection of pus, which will not readily unite, and will permit the easy exit of matter." In this way deep cervical and post-pharyngeal abscesses, deep abscesses of the thigh, leg and forearm, may be fearlessly opened.

After-treatment. When an abscess has been opened it should be left to discharge by itself, a simple poultice or warm-water dressing being applied over the surface. Any squeezing or pressing upon the walls of the abscess is unnecessary and injurious. In some, it is well for a few hours to introduce a piece of oiled lint between the edges of the wound to prevent its closure, more particularly when the deep fascia has been opened; whilst in others of large size, the introduction of "a drainage tube" made of a piece of india-rubber tubing perforated at intervals may be required.

Tonics and diet. Tonics and good feeding are always essential elements in the treatment, sedatives being given only when required.

When early opening requisite. In acute inflammation about the hand or foot an opening cannot be made too early; indeed, it should be made as soon as effusion has taken place, and the soft parts are tense. Under these circumstances an early incision by relieving tension will often save tissue, and the operator must not think that he has done wrong when, on making the incision, he finds no pus exudes.

On opening chronic abscesses. When a *chronic abscess* requires opening—a question which in every case should be well considered—a free incision should be made into its cavity, its contents evacuated, and the cavity well washed. For this latter purpose nothing has answered so well in my experience as a mixture of one or two drachms of the tincture of iodine to each pint of tepid water; a drainage tube should then be introduced, care being taken that if air enters, its exit also can be guaranteed. The abscess should be washed out daily.

Lister's plan of opening chronic abscesses. Mr. Lister's plan of covering the opening with a piece of lint soaked in carbolic oil, to prevent the possible admission of air or any septic matter, seems good, whatever may be the theory of its action. I have treated by these means an obscure case of abscess, in a young lady, æt. 18, of the left loin and abdomen, spreading as far as the median line, and showing itself below Poupart's ligament. Quarts of pus were evacuated, and the whole closed within a month, or rather degenerated into a small sinus which discharged serum for three or four weeks and then healed without the slightest constitutional disturbance. I have treated likewise a spinal psoas abscess, and others of the thigh and loin, with equal success; while another, clearly renal in its origin, might be recorded to support the practice.

Free opening. The practice consists in making a free opening into the abscess, and then applying over it a piece of lint soaked in carbolic oil (one part of acid to twenty of olive oil), beneath which the pus flows away; in this manner no air is admitted In the subsequent dressings care must be taken to keep the opening surrounded with the vapour of the acid, and the lint should only be removed and be replaced by a freshly steeped piece. No pressure should be made upon the walls of the abscess for the purpose of emptying its cavity without the opening being

covered with carbolic oil. I have, however, used, in several cases, olive oil alone with equally good results. With the similar object of excluding air and its impurities, the use of the trocar and canula have been suggested, a valvular skin opening being secured by drawing the integument to one side before making the puncture. The trocar invented by Mr. Thompson, of Westerham, is also good. In it an elastic tube is fitted to a second month below the instrument. But beyond any of these in their usefulness, when such a practice is demanded, Dr. G. Dieulafoy's "aspirator" is to be preferred; for by it the contents of any cavity can readily be *explored* or withdrawn, without the possibility of the entrance of air.

Trocar and canula.

Aspirator.

Suppurating ovarian and hydatid cysts may be treated as large abscesses, and with considerable success. Empyemata or abscesses in the chest can also be dealt with on the same principle, by a free opening into the thorax and a free outlet for the pus. In these cases the drainage tube is of great value, care being necessary to drop one end of it well down to the bottom of the cavity.

The drainage tube was suggested by M. Chassaignac, and is simply a small india-rubber tube, perforated every inch or so with holes to allow of the free escape of the pus. When large cavities are opened they should be washed out, at intervals, with an iodine lotion or Condy's fluid, so that nothing like decomposition, as indicated by fœtor, may be allowed. With this precaution large suppurating cavities can be dealt with successfully.

Drainage tube.

When veins and large arteries are opened, by ulceration, into abscesses —an accident of occasional occurrence—they should be treated on the principle laid down in the chapter on hæmorrhage; *i.e.*, if the bleeding vessel be large, it should be secured at the point at which it has given way, either by ligature or torsion; and if small, the hæmorrhage can easily be arrested by pressure.

Chronic abscesses associated with glandular enlargement need not be opened under some circumstances, because with constitutional treatment they often disappear; yet they should be so treated as soon as it is clear that they will open by natural processes, if let alone, in order to save the ugly cicatrix that takes place under these circumstances from ulceration of the skin. The surgeon should make a small puncture in the best line to allow of the exit of the pus and to prevent disfigurement. Gentle pressure with cotton wool over the part afterwards, often hastens the recovery. In subjects of the hæmorrhagic diathesis an abscess may be opened by the cautery or canula.

Abscesses associated with enlarged glands.

Arrest of Acute Inflammation by the Obstruction of the Main Artery of the part.

To arrest acute inflammation in a limb, the deligation of the main artery of the limb, or the arrest of the circulation through it by pressure upon the artery, has been adopted. Dr. Campbell, of New Orleans, speaks highly of the practice, and even affirms that no portion of an extremity should be amputated for destructive inflammation without this experiment being attempted. On the suggestion of Mr. Maunder, of the London Hospital, Mr. Little, in 1867, applied a ligature to the femoral artery for acute suppuration of the knee, with a success sufficient to prove the value of the practice. Mr. Maunder, too, has since successfully had a similar result ("Lettsom. Lect.," 'Lancet,' 1875). The late Mr. Moore, of the Middlesex Hospital, also acupressed the brachial

On arrest of inflammation by deligation of main artery.

Examples.

artery with a good result. Previous to these cases, however, as early as 1813, Dr. Onderdonk, of America, ligatured the femoral in a case of wound of the knee-joint, to check acute inflammation, and others since his time have followed his practice. It is a method of treatment certainly worthy of attention, inasmuch as to cut off the supply of blood to an inflamed part, when too much is passing to it, is sound in theory; and to do the same to starve out the disease is equally scientific. In elephantiasis Arabum the practice does not seem to be without its good effects, and, in acute disease, it is certainly admissible.

I well remember, as a student, observing, under the care of Mr. Bransby Cooper, a serious case of compound fracture of the leg, complicated with a severe laceration of the thigh and division of the femoral artery of the same side. He was in doubt as to the practice he ought to follow, not knowing whether with the divided femoral the supply of blood would be sufficient to repair the compound fracture. The success of the case, however, proved that the fear was groundless, for repair went on uninterruptedly, and a good limb was the result. The patient was a man of middle age. In 1873 I also treated with uninterrupted success a case of compound fracture of the humerus into the elbow-joint in a man where the brachial artery was obstructed, recovery with a movable joint being accomplished.

On digital compression of main artery in inflammations.

With respect to the treatment of inflammation by the *digital* compression of the main arterial trunks leading to the injured or diseased parts, it must be recorded that in 1861 Dr. T. Vanzetti, of Padua, wrote a paper upon the subject, which Mr. S. Gamgee has translated in his work 'On Fractures' (1871). He was led to apply this treatment to cases of inflammatory disease from its success in the treatment of aneurisms. He asserts that compression will cure every incipient inflammation, and check it even when advanced, and he adduces cases of phlegmonous erysipelas and acute arthritis of the hand successfully treated by such a process. He adds, however, that "in the treatment of aneurisms as of inflammations, compression can never become a normal method until it be always and exclusively effected with the finger."

SINUS AND FISTULA.

On sinus and fistula.

Definition.

Varieties of fistula.

A fistula is an unnatural communication between a normal cavity or canal and the outside of the body or second cavity or canal.

A sinus is a narrow suppurating tract with only one orifice.

Both will now be considered. Thus, amongst the *fistulæ*, there are the vesico-vaginal and the recto-vaginal fistulæ in women; the recto-vesical in men; fæcal fistula, gastric and biliary fistulæ, anal fistula, salivary fistula, and urinary fistula. They are always due primarily to some suppurative or ulcerative process, or mechanical violence, operative or otherwise, and subsequently, to a want of repair. When passages are close together, the fistula will be short and direct; in some large, in others narrow or tortuous. When the cavity or canal is deeply placed, or the inner opening deeply situated, the fistula may be a long narrow tract. When the fistula is of *recent* origin and lined with granulations discharging pus, the walls will be soft, readily bleeding on manipulation. When *old*, they will be smooth and hard, "callous" all over, and non-sensitive, secreting a thin, watery, non-purulent fluid. This fluid is, moreover, mixed with the contents of the cavity or

tract with which the fistula communicates, the discharge tending to keep the fistula open.

External orifice of fistula.

The *external* opening of a fistula or sinus presents very different appearances. It may appear as a direct or as a valvular opening, depressed, or raised. When leading down to a foreign body or to bone, the external orifice will be surrounded by weak granulations. Sometimes it may scab over for a time, and then reopen by the force of the retained fluid.

Internal orifice of sinuses.

The *internal* opening of a fistula mostly appears as a defined orifice.

Of *sinuses* or incomplete fistulæ, abscess is the most common cause; the external communication failing to close from some defect in the healing power of the part; from some interference with the reparative process; from the constant discharge of pus, which has not a sufficiently free vent; from muscular action, which forbids that amount of rest of the part which is required for its repair; or, lastly, from the presence of some foreign body introduced from without, from dead bone or cretaceous inflammatory product from within.

Treatment of fistula.

The TREATMENT of the different forms of fistulæ is given in the chapters devoted to the special organs that are involved. In a general way, however, it may be asserted that so long as the cause of the fistula exists, repair cannot go on; so that, in urinary fistula, when stricture is the cause, the stricture must be treated before the fistula. In anal fistula, when the action of the sphincter ani forbids repair, its action must be paralysed. In fæcal fistula, when obstruction to the bowel is present, the obstruction must be removed. In salivary fistula, the salivary duct must find a natural outlet before its unnatural orifice can be expected to close. When any foreign body, tooth or dead bone, is keeping the sinus open, it must be removed. When a suppurating cavity at one end of the fistula continues to discharge, means must be taken to close it. When these objects have been achieved attention may be directed to the fistula or sinus itself, and various are the means that can be employed for their cure.

Remove cause.

Pressure.

Pressure in *recent* sinuses, to keep the parts in apposition, by means of pads, strapping, or bandages, is sometimes of use, the muscles that move the part being kept absolutely at rest thereby. In stumps, and after mammary abscesses, this practice is very beneficial.

Injections.

Seton.

Cautery.

Injection of some stimulating fluid, such as the preparations of iodine (either the tincture alone or diluted with one or two parts of water) will sometimes set up a healthy action; for the same purpose a *seton* has been used, and of all setons the small *drainage tube* is the best, or a narrow coil of rolled gutta-percha skin. The *cautery* is sometimes of great use, and the galvanic is to be preferred It can be accurately applied to the exact spot, and its heat maintained for any required time. It is generally most useful in small fistulæ.

Laying open fistula.

Laying open the sinus is, however, as a rule, the best plan, dividing it from end to end, and keeping the sides asunder to allow of its healing from below. When done with a knife the incision is to be made upon a grooved probe or director which has been previously introduced through the sinus. This, however, may often be done to great advantage with the wire of the galvanic cautery. When the cautery is used, the wire should be passed through the sinus on the grooved director, or threaded in an eyed probe; the surgeon then holding the two

Division by cautery.

ends of the wire, made hot by contact with the battery, and dividing the tissues with a sawing motion. The division with the cautery has this advantage, that the surface of the sinus is so destroyed that it must granulate. There is consequently less need of careful dressing, and in old sinuses this is a point of importance, for their surfaces are so callous that they require to be scraped or otherwise rendered raw, to permit of granulations forming.

The division of a fistula with a ligature is now rarely performed, although with an india-rubber ligature it is feasible. In "bleeders" it might be called for, but in these the wire of the galvanic cautery is preferable, when it can be obtained.

Plastic operations for the cure of fistulæ are also means of great value, particularly of vaginal and rectal fistulæ. These will be discussed in a future chapter.

Constitutional treatment of fistula.

Last, but not least, in the treatment of sinuses and fistulæ, constitutional treatment should be employed. In the fistula following operative or suppurative action, such treatment is, as a rule, all that is wanted, and many are the cases in metropolitan hospitals of sinuses about stumps, skin wounds, or mammary wounds, that will heal rapidly under the influence of fresh air, good food, and tonic medicine. In all cases these means are most essential, and, with them and local treatment, success is generally to be attained.

ULCERS AND SORES.

Ulceration is an inflammatory process, in which a *sore* or *chasm* is produced by the molecular death of the tissue involved.

Definition of an ulcer.

A sore is a chasm, a solution of continuity, caused by ulceration upon an external or internal surface of the body.

When a *sore* is being formed, or is spreading by the process of ulceration, an *ulcer* is said to exist; when the ulceration has ceased, a *sore* remains.

Varieties according to progress.

When an *ulcer* spreads rapidly it is termed *phagedænic;* when it spreads by gangrene, *sloughing;* and when with this gangrene the molecular death of the tissue, or ulceration, is combined, *sloughing phagedæna* is said to exist. All these processes are consequently different forms of different ulcers, and are characterised by degrees of rapidity of the process; the simple ulcer being the mildest, and the sloughing phagedænic the most severe form.

Varieties according to condition of ulcer.

A healing sore heals by *granulation* and *cicatrisation*, the process of healing being the same in it, as it is in any open wound the result of injury or operation. Sores may be *healthy, inflamed, weak, indolent, sloughing from excess of indolence,* or *irritable,* terms which are applied to sores to express their conditions at the time, but having no special signification, for these appearances fluctuate according to the general condition of the patient and the local treatment of the sore. A sore may also at any time take on the ulcerative process and spread, or assume any of the forms of spreading already described.

An ulcer may originate from a *local* or a *constitutional* cause.

Local causes of ulcer.

Among the *local causes* are injuries produced by blows, pressure, or some irritating application, or some skin eruption set up or followed by inflammation and subsequent ulceration. If a piece of skin dies, it is cast off by ulceration; if a portion of integument

inflames from some external irritation, a local eczema or skin eruption, an ulcer follows. An abscess may form beneath the skin or in the deep parts, and burst by ulceration. It may be that some deep-seated disease was the cause of the abscess, but the ulceration spreads and remains as an ulcer.

Constitutional causes of ulcer.

Amongst the *constitutional* causes, *excluding cancers*, may be classed anything that superinduces a low condition of the vital powers, such as any illness, certain habits of life, syphilis, or scurvy.

It should be remembered, however, that ulcers which have a constitutional origin may be kept up by local causes—thus, a syphilitic or cachectic ulcer originating from a general cause may take on any of the characters common to the healing ulcer or sore, in the same way that a local ulcer or sore, produced from local causes, may fail to heal from some constitutional defect.

Special ulcers.

Lupus, rodent ulcer, epithelial or carcinomatous ulcers, stand by themselves, and are called *special* ulcers.

There are also **local** sores originating from local causes, which are often kept from healing through some general or constitutional failing; **constitutional** sores originating from constitutional causes, that may fail to heal on account of some local condition interfering with repair; and special sores. For the treatment of such it is most essential that the three different forms be recognised.

A local ulcer.

Local sores, as already stated, have a local origin—something causing inflammation and ulceration in the skin, and a sore remaining; the disease being cutaneous from the first. The few cases connected with disease of the deep-seated parts, such as the bones and joints, can readily be known.

A constitutional ulcer.

Constitutional sores have rarely a cutaneous origin, unless originating in some ulcerating skin eruption, such as ecthyma or rupia; but they almost always commence in the subcutaneous connective tissue as a more or less circumscribed induration, which lasts a very variable period, and then softens down; the skin over it inflaming, sloughing, and ulcerating, to give vent to a deeper slough; the sores or ulcers always being of a *cellulo-membranous kind*. These ulcers may have their cause in an ordinary cachexia or in syphilis, but the cellulo-membranous ulcer is always constitutional, and requires *general* more than *local* treatment. In syphilis the ulcers are the result of broken-down subcutaneous "gummata." The appearance of these sores will depend much upon the period at which they are seen; but, from the time when the skin has broken and ulcerated, the margins of the skin opening will appear thin, irregular, and undermined, and, at the bottom of the opening, the slough will appear. When simple, the slough will appear more or less white, sometimes pearly; but when syphilitic, it will have the aspect of a *piece of wet washleather*, at least, in the majority of cases. When any of the slough has come away the skin will at first be undermined, and the margin of the sore fall inwards, but, as the granulations rise from below, the skin will be pressed up, although when the wound has cicatrised, the scar will almost always be a depressed, and in syphilis, a stained one.

Cellulo-membranous.

Around this sore several small openings often coexist, each one having formed to give exit to a small slough, the margins of which appear as if they had been punched out. These sores occur mostly about the lower part of the thigh and knee, elbow, shoulder, and forehead, and are found,

Cellular-membranous specific ulcer.

however, in any part of the body. The syphilitic are always surrounded by a *dusky* kind of inflammatory border, and are rarely painful; the non-syphilitic with a pinker blush. The washleather slough and dusky margin clearly indicate the syphilitic sore.

It is by no means uncommon to discover in such a sore the specific character of a disease that had been contracted some twenty or more years previously, and that had lain dormant after having manifested its presence by marked symptoms. Indeed, it is from the occurrence of such sores as these that the surgeon enquires whether constitutional syphilis is really ever cured—that is, eradicated—and whether a man once syphilized, as once vaccinated, is not so permanently altered as to show under certain conditions, with comparative certainty, that he is still under the influence of the poison, and that other diseases must for ever after be modified by its existence.

Special sores will be described with the diseases from which they result.

Character of a healthy ulcer.

A healthy, healing, cutaneous sore is known by the small, florid, conical granulations that cover its surface, and the healthy creamy pus thrown off. "In granulations, new substances are formed as if the earth was taken in heaps from one place and laid in another; the *thicker and smaller the heaps* the better the granulations" (John Hunter, MS. lect., 1787). The granulations are not so vascular as to bleed, or so sensitive as to cause pain on the slightest touch. The margin is natural, and where the skin and granulations meet, a band of cicatrising tissue is to be seen, assuming, where in union with the skin, a whitish line with a fine covering of epidermis; but where in contact with the granulations a more vascular appearance than at any other part of the sore, the centre of the band being covered with a thin, purplish-blue, semi-transparent film.

By the gradual and centripetal cicatrising process of the outer border of the band, and the gradual narrowing of its circle, the sore heals.

Treatment of healthy ulcers.

Treatment.—The surgeon's sole aim being to guard against anything that can interfere with the progress of repair, the treatment is simple; a piece of wet lint to absorb discharge and protect the surface of the sore from injury being all that is required, the lint being kept moist by a piece of oil silk, gutta percha, or elastic tissue. Where water irritates, oil may be substituted. The surface of the sore should be cleansed by means of a stream of tepid water; sponges should never be used, and cotton wool is the best substitute, as it can be destroyed after use.

Where the granulations are disposed to rise too high, dry lint may be applied, and at times a good rub with lunar caustic hastens recovery. Small sores thus treated may be allowed to scab. Rest is always beneficial in aiding repair, but should this be impracticable, a good bandage may be substituted, and a piece of thin sheet-lead bound over the sore outside the dressing will give efficient support. In removing the dressing, care should be taken not to injure the band of delicate cicatrising tissue.

Deviations from typical sore.

Accepting this description as that of a healing sore, deviations from this type constitute the different forms that have been described. Thus, when the granulations assume a large, pale, elevated, watery appearance, the sore is said to be *weak*, the granulations in popular language being "proud flesh," the popular word "*proud*" being synonymous with *weak*. There is power in the sore to granulate, but

the granulations have little power of cicatrising, they are disposed, moreover, to slough on the slightest cause. These require local stimulants, such as the nitrate of silver in stick, sulphate of zinc or copper lotion, carbolic acid lotion in the proportion of two grains to the ounce, or terebene alone or diluted with one or two parts of olive oil. Dusting the surface with powdered alum or tannin is also sometimes beneficial. The weak ulcer and its treatment.

The limb should be carefully elevated or bandaged, and the general health attended to.

When there is still less power in the sore no granulations form, the surface puts on the appearance of a piece of mucous membrane, such as that of the pharynx, the sore being then called *indolent*. At times a few weak granulations are found at one corner of its surface, but the greater part has a smooth and glassy aspect, with a thin and watery, but not purulent secretion. Where the sore has existed long the edges will appear raised and indolent, covered with a layer of epithelium, and very senseless. It then acquires the term "*callous*"—a callous sore being an indolent one of long standing. This indolent sore is always ready to take on a sloughing action on any slight cause, such as some general derangement of the health, or the long assumption of the dependent position of the limb. It is common, indeed, to find the surface of the indolent sore *sloughing;* not, however, from inflammatory action, but from *extreme indolence in the granulating force.* Under these circumstances the surface of the sore becomes covered with a greenish secretion often fetid, the granulations forming partially, and ultimately dying. When the sore is large, this appearance is very commonly towards its centre, or lowest part; and as repair goes on, the sore may cicatrise at its edges, where the granulations derive the full benefit of the vascular and nerve supply, while the centre of the sore still sloughs. In old people the margin of the sore may slough in one part and heal in another. Authors have described this indolent sore in the old as *senile ulcer.* These sores are very common and are usually found in the lower extremities, often, too, associated with varicose veins; this condition of veins has, however, little to do with their origin, although it tends much to retard their recovery. These have been described by old authors as *varicose ulcers*, simply from the fact of the two conditions being often found together. Such are almost always found in weak subjects, with a feeble circulation. The indolent and callous ulcer. May become sloughing. Senile ulcer.

The treatment of these indolent sores consists in encouraging the venous circulation of the part by position if possible, and by pressure where rest cannot be secured; by local stimulants, and by general tonic treatment. When there is little or no action in the sore, the application of one or more blisters to the surface is very beneficial; or blistering liquid may be painted over its edges. When the surface is sloughing, half an ounce of carbolic acid or of terebene to a pint of olive oil with or without the extract of opium, according to the amount of pain, is an excellent application. Where the edges of the sore are indurated and callous, so that cicatrisation and contraction are almost impossible, the free scarification of the margin every half inch is often followed by a rapid change for the better; or two free incisions may be made on either side of the margin of the sore for the same purpose. During this treatment, if the venous circulation is assisted by raising the leg higher than the hip, the utmost good may be obtained. When rest cannot be observed the limb may be strapped up from the toes to the Treatment of indolent ulcers.

knee—omitting the sore—firm pressure being applied by means of a piece of sheet-lead and a bandage over the dressings. In private practice, when the leg can be dressed daily, the whole limb may be covered with the strapping. The strapping, therefore, ought to be good, not such thin material as that spread on calico, nor thick, felt strapping, but that spread on linen, such as is sold by Leslie, or Messrs. Gerrard and Co., and used at Guy's Hospital.

May become painful and irritable.

When the sore is painful, or the patient has an irritable pulse, the beneficial effects of opium twice a day in a pill are very marked; and quinine, iron, nux vomica, or the vegetable bitters, may be given, as the wants of the case indicate. The bowels also require attention,

Transplantation in extensive ulcers.

drachm doses of the sulphate of magnesia, with quinine, being a good aperient. When the sore is unusually large, and there is little probability of the whole healing from loss of skin, fresh centres of *cutification* should be inserted by transplantation. In this way I have brought about the cicatrisation of a large sore of twenty-four years' standing in three weeks, and many others of smaller size in an equally short period; indeed, by this practice of skin-grafting, I believe the necessity of amputation in the more severe forms of this affection will be greatly diminished; for hitherto indolent ulcers that surround a limb have ever proved themselves incurable, amputation being their only remedy.

The inflamed ulcer.

All sores may inflame or become irritable, but there is an *inflamed sore* or *ulcer* which is found in subjects with thin and fair skins who are in some way reduced in power, or "out of sorts," either from irregular living, over-work, or bad feeding. It appears as a small

Eczematous.

superficial, inflamed, irritable sore, with a raw-looking appearance, an ash-coloured slough, or thick secretion over its surface, and discharges a thin, ichorous fluid, sometimes tinged with blood. The patient will complain of its excessive painfulness, particularly at night, and will dread its being touched. It will look red and angry, though superficial. A blow or a graze may have caused it, or a local patch of eczematous inflammation, in which case it may be described as an *eczematous ulcer*.

Treatment of inflamed and irritable ulcer.

The *treatment* of these sores is very troublesome, the skin being usually highly sensitive. They always want soothing, and the best lotion is one of lead mixed with extract of opium, but this sometimes irritates, while the lead or zinc ointment gives comfort. At other times a cold bread poultice is the best application. In all cases the limb wants rest and elevation; plasters rarely being tolerated. In the eczematous sore, where the discharge from the eruption round the sore is profuse, the powdered oxide of zinc and starch, in equal proportions, may be used; or, the surface may be washed with a solution of nitrate of silver in the proportion of ten grains to the ounce. Occasionally a solution of the extract of opium is the best lotion. Simple nutritious food, with a moderate allowance of stimulants, should be administered but all high feeding is injurious. The general health mostly requiring tonics of a non-stimulating kind, such as the vegetable bitters with alkalies, as the intestines are generally irritable. When the pain is severe, opiates and sedatives are indicated. In very inflamed sores the application of a few leeches occasionally gives relief at some distance from it. These sores are invariably obstinate.

Varicose ulcer.

Authors describe a *varicose ulcer*, but it is questionable whether such exists. Many indolent sores are doubtless associated with varicose veins, and are probably indolent on account of this association; but how far they are really caused by them is a different matter, for varicose veins and ulcers of all kinds are constantly met with together. Of all ulcers entitled to the term varicose, the eczematous has probably the most claim, for certainly eczema of the leg is a common consequence of varicose veins, and an ulcer the result of the eczema.

Ulcer associated with varicose veins.

Must treat the varicose veins at the same time.

Practically, however, it is well to remember, that when varicose veins exist *with* an ulcer, repair cannot go on favorably unless the venous circulation of the limb be assisted by position or pressure; and that where these varicose veins are present, all ulcers or sores are disposed to become indolent if neglected. When an ulcer takes its origin from an inflamed vein the term is applicable, in a measure, but this ulcer has no special characteristics.

Sores that are prevented from healing by varicose veins must be treated by the elevated position of the limb, by bandaging or strapping, and, in bad cases, by the obliteration of the veins. Without this obliteration the treatment will, of necessity, fail; whereas with it the sore may be expected to heal with the use of such general and local means as its nature may require.

Question of healing chronic ulcers.

How far it is right to heal an old chronic sore has not yet been quite decided. Older surgeons declared it to be inexpedient, as cases were met with in which apoplexy or some other alarming condition supervened. Modern surgeons, however, are disposed to question the explanation of these facts, and to look upon that practice as beneficial which removes any abnormal condition, local or general. Still, it is wise, when a patient has been in the habit of losing by discharge from the surface of a sore, a certain amount of material which would otherwise have been used to maintain the general powers, to cut off the supplies in another way, to order more abstemious living, and to regulate the bowels by some saline water, natural or artificial, as may suit the stomach.

Sloughing ulcers.

Sloughing and phagedænic sores are rarely seen, except in connection with syphilis or hospital gangrene. In syphilis, sloughing is found in the intemperate and ill-fed, and mostly in gin-drinking prostitutes. It attacks any surface that has been made sore, either from venereal contact or other causes; and it is marked by the rapid way in which the process destroys tissues, by the fœtid character of the discharge, the great depression of power as an invariable accompaniment, and the constitutional disturbance.

Treatment of sloughing ulcers.

Opium in full doses is required for their TREATMENT, with tonics and good nutritious food. When this does not control the ulceration, the application of strong nitric acid with a piece of wood to the surface of the sore is often useful; sometimes, too, the local application of iodine or bromine in solution is of great benefit. Fresh air is always indicated, and abundance of disinfectants, such as Condy's fluid, or carbolic acid in some of its forms. These sores are mostly due to some feeble constitutional condition, and not to a local cause, although at times the local action seems to continue by itself, requiring some powerful escharotic, such as nitric acid, to check its course.

Paget's description of cold ulcers.

Sir J. Paget describes *cold ulcers*:—"They are like small inflammatory ulcers, occurring spontaneously in the extremities, especially at the ends of the fingers or toes, or at the roots of the nails. In some cases they are preceded by severe pain and small gangrenous spots. They are, in many respects, like ulcerated chilblains, but they occur without any exposure to intense cold in patients whose feet and hands are commonly, or even habitually, but little warmer than the atmosphere they live in. Such patients are among those who say they are never warm, and the skin of their extremities, unless artificially heated, is to the touch like the surface of a cold-blooded animal. With this defect, which is common in women, there is a small feeble pulse, a dull or half livid tint in the parts which in healthy people are ruddy, a weak digestion, constipated bowels, and scanty menstruation.

Treatment of cold ulcers.

"The cure of the ulcers and prevention of their recurrence lie in the remedy of these defects. Many tonic medicines may be useful, but the most so is iron; with it purgatives are generally necessary, *e.g.* small doses of mercury and aloes or of sulphate of magnesia. Full diet also is required, exercise in the fresh air, very warm clothing, especially of the lower half of the body, and warm bathing; dry applications, or lotion of sulphate of zinc or copper, are the best local means, and the part must be kept warm; healing is always tardy at a low temperature."

Allied to cold ulcers are those formed on fingers or other parts which have been deprived of their nerve supply by some injury.

Busk's scorbutic ulcer.

Scorbutic Ulcer.—In Sir J. Paget's able article in 'Holmes's System' occurs the following description of the scorbutic ulcer by Mr. Busk:—"Although scurvy in itself cannot be said to be attended with any peculiar form of ulceration, ulcers or sores of any kind already existing from other causes assume, in consequence of this scorbutic taint, a more or less peculiar character, and, when thus modified, have been usually termed 'scorbutic ulcers.'

Pathology of scurvy.

"Scurvy essentially consists in an alteration in the constitution of the blood, which leads to the effusion into the various tissues of a *fibrinous exudation*, usually deeply coloured, and which has on that account been commonly regarded as a simple coagulum. That this effusion, however, can scarcely be regarded in this light, is proved by several considerations, but more especially by the circumstance that it is from the first *solid* and *capable of becoming imperfectly* organised; that is to say, it is after a time permeated by newly-formed vascular channels. It is the presence of this effusion which causes the spongy swelling of the gums, the tumefaction and induration of the intermuscular tissue, the so-termed *scorbutic nodes*, and which, when poured out on the surface, or in the substance of the corium, constitutes the vibices and petechiæ so characteristic of the disease. It is the *effusion also of the same semi-plastic material on the free surface of sores or ulcers which gives them the peculiar aspect termed scorbutic.*"

Character of the scorbutic ulcer.

"Ulcers of this kind are distinguished by their livid colour and irregular tumid border, around which no trace of cicatrisation is evident, whilst the surface of the sore is covered with a spongy dark-coloured, strongly adherent, fœtid crust, whose removal is attended with free bleeding, and is followed by a rapid reproduction of the same material. This crust, in bad cases, as remarked by Lind, attains to a 'monstrous size,' and constitutes what has been appropriately termed by sailors 'bullock's liver.'"

The Syphilitic Superficial Sore.—The deep cellulo-membranous syphilitic sore has been already described (page 27), under the heading of constitutional sores, but the *superficial, cutaneous, rupial syphilitic* sore deserves notice, because it is very common. It mostly succeeds an ecthyma or rupia, is mixed with the eruption in some other stages, and is simply an ulceration of the base of a syphilitic eruption. This goes on increasing irregularly in a serpiginous form, the sore healing in one place and spreading in another; but it involves only the skin. The edges of the sore, or sores—for they are often numerous—are usually well defined, and frequently irregular; the surface too is generally of a deep colour; and, when healing, may either scab or granulate, as any other sore. They are met with at any period after the first constitutional symptoms of syphilis have passed away, and occasionally at a remote date; they are always found in a cachectic or enfeebled subject; indeed, it appears as if want of power allowed the disease to manifest itself in the new form. Period of appearance.

The treatment of these sores, when once recognised, is not usually difficult. Tonics, with the iodide of potassium or sodium, in doses of from three to ten grains, usually effect a cure, at least for a time; liquor cinchonæ and compound spirit of ammonia in half-drachm doses are also good remedies. In other cases quinine or iron is indicated. Mercurial remedies are sometimes, though rarely, necessary; perchloride of mercury, in doses of $\frac{1}{10}$th of a grain in bark, green iodide in one-grain doses in a pill, or the mercurial suppository, being the best forms to employ. Treatment of the cellular-membranous ulcer.

Locally, the sores may be dressed with any simple dressing, but when indolent, a mercurial lotion, as the black wash, is the best.

Lupus must be classed amongst the ulcers. It is met with in two forms—the *lupus erythematosus* and the *lupus vulgaris*—the latter being more common in young scrofulous subjects, and the former in the middle-aged. When associated with a spreading ulceration, it has been called *lupus exedens.* On lupus. Varieties.

The "lupus erythematosus" occurs chiefly upon the face, and is symmetrical; each patch has well-defined edges, and a red, scaly surface, with small horny points upon it, due to accumulation in the dilated mouths of sebaceous ducts.

The "lupus vulgaris" has its origin in a skin tubercle, or tubercles, of a flat form, fleshy consistence, and pink shining appearance, and these at times ulcerate. This lupus ulceration when once originated, progresses steadily, destroying every tissue it attacks, and when it reaches the nose—its very favorite seat—it simulates cancer. The surface of the sore is sometimes free from all signs of granulations, and often very irregular, while the edges are ragged, raised, and often everted. It is painless. The tubercles themselves feel spongy, are not so hard as cancer, nor so well defined. Characters of lupus ulceration.

These lupus ulcers are more commonly found on the face than elsewhere, and probably next in frequency, on the female genitals. They are most destructive when left alone, but often very amenable to treatment. In young adult life they are more common than in the old, and appear closely allied to tuberculosis.

Treatment.—Although the disease has probably a constitutional origin, and requires tonic treatment, both by medicine and regimen, there is no disease that derives more benefit from local treatment. Treatment of lupus ulcers.

When the ulceration is superficial, and the skin is not deeply infiltrated, the local application of cod liver oil on lint, and the covering up of the part with cotton wool to keep it warm, has at times worked wonders. But under other circumstances, when the skin is deeply involved and infiltrated with disease, the free destruction of the whole growth is the best treatment, and this may be effected by scraping the surface of the growth, by caustics or cautery. Since employing the galvanic cautery as a local caustic, I have burned down many of these lupus ulcers, and even tubercles, and been surprised to find how rapidly a healthy cicatrix forms. Paquelin's thermo-cautery seems, also, of equal value.

Their local destruction.

Where this treatment is inapplicable, the destruction of the surface by some escharotic should be undertaken, the chloride of zinc paste being probably the most effective. But whether the galvanic, or thermo cautery, or escharotics, be used, it is essential that the whole tissue be destroyed down as far as the healthy structures. In some cases I have scraped or broken down the growth with the handle of a knife, or even cut off the margins, and then applied the cautery to the base of the sore. The same practice may be followed when caustics are applied. In exceptional examples excision is beneficial, the sore being left to heal.

Rodent and cancerous ulcers will be treated under the head of tumours.

BED-SORES.

Bed-sores.

In theory bed-sores should never occur; yet in practice they appear in certain cases, in spite of the greatest care and attention. It is well, however, for the surgeon to act upon the theory, as by so doing he is stimulated to do everything in his power to guard against their occurrence, and no better illustration of the old adage, "Prevention is better than cure," could be found than in such a case.

Bed-sores may briefly be described as the death of a part from mechanical pressure, the parts involved in some cases literally dying from being deprived of their nourishment by prolonged and continued pressure; in others from some inflammatory action induced by it.

Bed-sores may arise in healthy subjects who are kept unmoved for ten or fourteen days; but in the old, the fat, or very thin they may occur at an earlier date, as they do in fever cases of all kinds, and in spinal or partially paralytic cases; completely paralysed parts are less prone to slough than the partially paralysed.

Dirt and moisture under all circumstances accelerate their appearance.

A bed-sore may appear as a simple abrasion, a sloughing of the skin, or subcutaneous tissue, and in severer cases the exposed bone may die, and in the worst the spinal cord may be opened.

Their treatment.

Treatment.—Since, as a rule, they are caused by continual pressure on a part, they may very generally be averted by some change of the patient's position. The necessary amount of movement may, as a rule, be allowed in all medical and in most surgical cases, but local pressure under all circumstances should be periodically relieved.

The skin of the part pressed upon should be hardened by washing it, at

least twice in the twenty-four hours, with some camphor spirit and water, vinegar and water, or nitrous ether and water, in the proportion of one part to three. An artificial covering of the flexible collodion is occasionally of great use.

When the parts are about to slough, these applications, however, are useless, and nothing but the removal of pressure will suffice. With this object, well-filled water beds and water or air cushions should be employed. I have found a mattress divided transversely into three parts and a water cushion substituted for the middle section of great use. At other times the sections of the mattress may be simply separated for a few inches in the line of pressure. Beds.

In spare patients, where the spinous processes of the vertebræ are prominent, thin strips of felt plaster placed vertically down the back give great relief, and the same plaster applied to other painful parts is of value; cushions of amadou and well-adjusted pads of cotton wool or spongio-piline are also always of service.

When sloughing is present, a linseed-and-bread poultice with a solution of carbolic acid, of iodine, Condy's fluid or charcoal sprinkled upon the surface is the best application, though a carrot or yeast poultice occasionally cleans the wound.

When the slough has separated, some stimulating lotion or ointment may be required; this is best applied on cotton wool.

In all cases where patients have to rest for a lengthened period, careful attention should be paid to keep the bed smooth, and the sheets free from rucks. Corded or feather beds should not be used. The best is a horse-hair mattress placed upon a second or spring bed.

MORTIFICATION, TRAUMATIC, ARTERIAL, AND VENOUS.

The mortification of any part of the body signifies its death. When a soft part is "dying," it is said to be in a state of "gangrene;" and when "dead," in that of "sphacelus." The dead portion is called a "slough," and the process of separation the act of "sloughing." When bone is dead, the term "necrosis" is employed; the dead portion being called the "sequestrum," and the process of its separation "exfoliation." Definition.

The dead portion of any tissue is thrown off from the living by means of ulceration; and when the slough has separated, the parts heal by granulation, as an ordinary wound. In the "sloughing phagedæna" the two processes of ulceration and sloughing are combined, the molecular death of a part, or ulceration, going on with the more general destruction of gangrene.

Direct violence, mechanical or chemical, may be the cause of mortification, either by destroying the vitality of a part at once, or by exciting inflammation in it which induces its death, such cases being called "traumatic." In this group a large proportion of the cases of gangrene are found. Causes. *a.* Traumatic.

In the second group are found those in which a part is starved, the main artery of a limb being obstructed, either from operation, accident, or disease—this may be called anæmic gangrene. *b.* Anæmic.

In the third group may be classed all those cases in which the stagnation of blood is caused by the mechanical arrest of the circulation *c.* Static.

through the veins, complicated or not, with secondary inflammatory action. This form is called "static gangrene."

In each and all of these, inflammation plays directly or indirectly, an important part.

Tissues suffering from defective nutrition, either as the result of some want of nerve supply or energy, or of extreme debility the consequence of severe illness, or other depressing influence, are more prone than others to mortify on slight causes.

Moist and dry gangrene.

When mortification takes place in tissues that are filled with blood, and more particularly with inflammatory fluids, "moist, hot, or humid gangrene" is produced; but when it takes place in parts in which no such stasis exists, and where death of the tissues is the result of a want of arterial supply, "dry, cold, or chronic gangrene" is caused.

These two forms, however, are in a measure convertible—the rapidity of the process and the amount of inflammatory infiltration influencing the result.

Direct traumatic gangrene.

Direct traumatic gangrene is well seen in the destruction of skin from the contact of some corrosive acid, such as sulphuric or nitric acid; the black or yellow slough which immediately follows the application of the caustic testifying to its action.

Indirect traumatic gangrene.

Indirect traumatic gangrene is also well seen in the integument after the application of a blister to a child or feeble patient, the blister being followed by inflammation of the blistered part, and its subsequent death.

As seen in compound fractures.

In bad compound fractures the indirect inflammatory gangrene is often illustrated, the limb swelling rapidly, and the skin assuming a mottled and livid hue; loose blisters or phlyctenæ of raised cuticle soon forming on the surface, containing more or less blood-stained serum, while the tissues become sooner or later cold and insensible, the temperature of the part often falling rapidly. The fluids from the wound, when any are present, soon become offensive, blood-stained, and mixed with gas—the tissues crepitating, on pressure, from its presence.

Line of demarcation.

The gangrene may be limited or it may spread upwards, but when the action has attained its limit, the living tissues in contact with the dead become highly vascular, and a defined line, "the line of demarcation," at length appears. This vascular line goes on to ulceration, and, if left to take its course, to the separation of the whole slough from the living tissues: soft parts, and even bone, may be divided by it, the granulations on the new surface materially assisting the casting off of the slough. The deeper tissues of a limb thus affected, rapidly decompose and give rise to a horrible fœtor; the extent of decomposition will depend much upon the fluids in the part. Should the limb be exposed the integument will soon dry and become black, and gradually wither, while the soft parts beneath will undergo decomposition.

Rarely attended with hæmorrhage.

This process is rarely attended with hæmorrhage, the blood in the vessels coagulating during the sloughing action, and thus obstructing them. In exceptional cases, however, sloughing of the vessels ensues—the more rapid the sloughing action, the greater, apparently, being the liability to bleed.

Direct traumatic gangrene is also well illustrated in cases of extra-

vasatiou of urine, or fæces, and probably also by the action of some auimal poisons.

Examples of anæmic gangrene.

The best examples of anæmic gangrene, *i.e.* gangrene *caused by the cutting off of the arterial supply to a part*, are found after the application of a ligatnre to a large artery, such as the femoral, for aneurism or injury; or after the contusion of an artery, which often, either by laceration of its inner coats (*vide* fig. 118) or by other means, is followed by its occlusion. Embolic plnggiug of an artery, the gradnal closure of a vessel from local arteritis or degeuerative disease, are other causes of this kind of gaugrene. In the same way is caused the abscess of the brain, or rather sloughing, that follows the application of a ligature to the carotid artery. In all these instances the part dies by starvatiou from waut of blood, and the more sudden the act by which the supply is cut off, the greater is the probability of gaugreue being the result. The suddeu occlusion of a large artery, whether in old or young, is liable to be followed by gangrene. Its gradual occlusion, exeept in the aged, is more rarely followed by sneh a resnlt, the collateral eireulation preventing it.

Senile gangrene.

In the form of gangrene called "senile," it is very probable that arterial obstruction, the result of atheromatous arterial disease, or of embolic plugging of the vessel from the breaking loose of some portiou of the diseased arterial coats, is the immediate cause of the gangrene; but the feebleness of old age, the degeneration of the tissues that have beeu badly supplied with arterial blood, coupled ofteu with some slight local iujury, are doubtless powerful ageuts in giving effect to the proess. One or more of these agents may be the true cause of the gangrene, but in the majority of cases they are probably combined. When the gangrene is purely a dry witheriug or mummifying process, the eause is probably the simple want of blood supply; but wheu inflammation coexists, the gaugrene will be moist, the feebly nourished tissues either from injury or otherwise, becomiug inflamed from some accidental cause, aud ultimately dying.

Gangrene from arteritis or embolism.

In the gangrene met with from arteritis or embolism in the young or middle aged, the dry one is the usual form—the parts becomiug cold, bloodless, waxy, rapidly witbering, turning black and then mummifying. Wheu caused by embolism, the onset of the gangrene, or rather the early indication of the pluggiug of the vessel, is marked by a sudden shooting or crampy paiu down the extremity, this symptom being speedily followed by those of "arterial gangrene."

When the occlusion of the vessel is gradual, this pain is uot preseut, and the symptoms of gangreue are more chronic.

Gangrene from cold.

Gaugrene from "cold" may be the direct result of want of blood supply, or may be indirectly caused by the iuflammation due to exessive reaction *from* cold: this latter form is called secondary mortification. The gaugrene following the use of the "ergot of rye" is dry, and follows precisely the same course of gangreue as that from arterial obstruction.

Gangrene from obstruction.

The best illustrations of gangrene *from obstruction—static gangrene*, as it might be called—are seen in such cases as strangulated feuoral hernia; after the use of splints too tightly applied; after the prolouged employment of the tourniquet to check hæmorrhage; in a tight paraphymosis; in the sloughing of protruding piles; iu the gangrene of a limb from the pressure of an aneurism or tumour upon the chief venous trunks; iu the sloughing of the legs, groins, or other parts of patients

suffering from some obstructive heart disease. In all these the parts may die from blood stasis, though inflammation, more or less marked, with its products, has generally an important influence in producing the result.

Mortification a compound process.

Mortification is thus a compound process, and is brought about by mixed causes—direct injury, want of arterial supply, and blood stasis from mechanical obstruction to the return of the venous blood being the three main exciting elements of the affection. At the same time, in each of the three classes of causes thus grouped together, inflammatory action has secondarily an important influence. Feebleness of power, old age, or want of nutrition, or nerve supply in a part, renders a patient or tissue more prone to the action of these causes, and the process more active.

Constitutional symptoms attending gangrene.

The constitutional symptoms associated with gangrene vary with its cause, but under all circumstances, a depressed condition of the ordinary powers is recognisable. In traumatic inflammation during the stage of excitement, the pulse may be rapid and the beat strong, the fever high, and other symptoms may be present indicative of sthenic action; but, when about to terminate in gangrene, all these symptoms will be marked by a sudden fall, the temperature of the body dropping four or five degrees, say from 104° or 105° to 99° F. Some interesting observations on this point by Mr. Pick will be found in 'St. George's Hospital Reports' for 1868.

When the mischief is extensive, and the gangrene spreads, what are known as typhoid symptoms may supervene. In the more acute cases death takes place very rapidly, but in the chronic, the constitutional symptoms are negative.

Treatment of mortification.

TREATMENT.—The most important point the surgeon has to bear in mind in the treatment of every form of mortification is, that the condition indicates a depressed state of the system; consequently the general treatment should be directed towards maintaining the patient's strength and cautiously building up the feeble powers by means of nutritious food, stimulants, and tonics, at the same time allaying pain by local and general soothing remedies, such as opium, morphia, or chloral, for nothing depresses more than pain.

Causes to be ascertained.

The *cause* of gangrene has also to be considered, for its influence on practice is most important. To treat a case of gangrene, the result of a local injury, as one due to obstruction of an artery would be clearly wrong, and to deal with an example of this latter form in the same manner as with another due to blood stasis the result of mechanical obstruction to the return of the venous blood of a part, would be unscientific. I shall therefore consider the question of treatment as applied separately to the three groups of cases already formed.

Treatment of traumatic gangrene.

a. When limited.

Treatment of traumatic gangrene, when of a *limited* nature, need cause but little anxiety. It should be treated on ordinary principles of local cleanliness, by poultices, water dressings, or the irrigation of warm water, with some antiseptic lotion, such as iodine lotion, sulphurous acid, Condy's fluid, carbolic acid, or chloride of zinc. When the slough has come away the surface is to be treated as an ordinary sore.

b. When extensive.

When the gangrene is more extensive and involving possibly a portion of a limb, *but yet defined*, whether caused *directly* by the injury or *indirectly* by the inflammation that followed, the expediency of removing the dead part by amputation is not to be disputed. No

more of it, however, should be sacrificed than is absolutely necessary, and to ensure this object the flaps to cover the end of the stump may be cut of any shape. Thus, in gangrene of the leg, it is better to amputate below the knee with any form of flap that can be made of sufficient size to cover in the end of the stump than at the joint, and it is far better to amputate at the joint than above it.

c. When spreading.

When, however, an injured limb is attacked with gangrene which is rapidly spreading, the difficulties are great. To remove it at once, as soon as the action has declared itself, would be to take away what often might be saved, or to do that which will not arrest the disease. To defer the removal, too often diminishes the prospects of recovery; and, subsequently the extension of the mischief, renders the amputation a more formidable one, or precludes the possibility of its performance. *It is wise, however, to amputate when the gangrene is extending, owing to the infiltration into the healthy tissues of the decomposing fluids from the parts.*

Question of amputation.

In a case of compound fracture, which is so bad as to suggest the necessity of primary amputation but in which the surgeon has been desirous, if possible, of saving the limb, the first onset of an inflammatory action that assumes a gangrenous form should be met by amputation; while in a case less severe, where the injured limb has a good prospect of being made an useful one, an attack of inflammatory gangrene need not necessarily lead to its loss.

Cases where amputation is useless and otherwise.

Where the gangrene is due to the injury, it will probably be limited, and may so terminate that a good limb can subsequently be secured. Where it is due to constitutional and not local causes, amputation of the limb will not arrest it; for the gangrenous action will in all probability attack the stump, and continue till it finds a limit or destroys life. If the patient lives, moreover, a line of demarcation will occur, and then amputation may be performed with a better prospect of success, whereas, if the patient dies, the surgeon will not have helped him to his end.

Gangrene from a local traumatic cause may be treated successfully by amputation, but a spreading gangrene the result of a general or constitutional cause, cannot be thus dealt with.

Opinions quoted.

In offering this recommendation it is right to add that it is against what is called authority. Erichsen says, "In traumatic gangrene, amputation should be performed as soon as the gangrene has manifested itself, without waiting for the line of demarcation." Spence writes, "In spreading gangrene, amputate without waiting for a line of demarcation." Pirrie says, "As the only chance of life, however slender, lies in immediate amputation, it ought to be performed at once, and high above the part affected." Brodie and Guthrie might be quoted for a like purpose, and H. Coote, in 'Holmes's Surgery,' ed. 2, says, "the indications for immediate amputation are so clear and generally acknowledged, "that he who shrinks from the responsibility of the operation stands exposed to just reproof."

But these authors do not seem sufficiently to recognise a difference between the gangrene due directly to the injury and involving the injured part, and the rapidly spreading gangrene which begins at the seat of injury and travels upwards; the *former* being directly due to the accident and generally confined to its seat; the *latter*, although indirectly due to the accident, being set up by some inherent weakness in the general power, which the local injury renders manifest.

Rule for guidance.

When the gangrene originates from a local cause, amputation is clearly the best practice; but when from a constitutional, it had better not be entertained till the action has ceased and a limit to the disease been formed. In Military Surgery there may be many reasons why this practice cannot be observed, for all conservative surgery, or treatment based on expectancy, has to be sacrificed to the exigencies of the moment.

Sir W. Fergusson was clearly led to this opinion on account of the absence of success he had met with in adopting the more usual practice, viz. amputation; for when he writes, "I might, however, possibly in future resort to a similar practice, but should feel greatly inclined to wait for a line of demarcation," it clearly must be accepted as being against amputation in spreading gangrene.

Treatment of spreading gangrene.

How then, it may be asked, is spreading gangrene to be treated? I reply, by tonics and local treatment based on general principles; by maintaining the part as free as possible from all fœtid discharges; by local cleanliness and the use of antiseptic applications; but chiefly by using all means at our disposal to give free vent to fœtid discharges and to relieve tension, employing incisions when necessary to secure these ends.

Local and general measures.

Under this practice, when nature is strong enough to check the progress of the disease, a limit to its extent will be formed, and the local affection will be amenable to treatment; but when no limit takes place, death will ensue, which amputation would not have arrested.

When amputation is deemed necessary, on the arrest of the action the limb should be removed as close as possible above the diseased part. There exists no necessity to sacrifice any tissue, and much less a joint, to make an amputation neat. The only point for consideration is, that the diseased tissues should be avoided, but beyond these no healthy structures should be sacrificed.

Treatment of anæmic gangrene.

In the treatment of gangrene due to arterial obstruction, the objects of the surgeon should be to prevent its extension, and to assist, when called upon, the separation of the parts.

To carry out the first of these the mortified parts may be wrapped in some lint dipped in oil, with or without carbolic acid, as indicated by fœtor; and the whole extremity should be raised to encourage the venous circulation, and surrounded with cotton wool to maintain its warmth.

Abundance of bland nutritious food should be given, aided with stimulants and tonics to assist digestion; the circulation, too, should be sustained, though anything like over-stimulating is reprehensible. Opium also may be given to allay pain, the patient being kept gently under its influence. Where small parts only are implicated, their separation may be left to nature; but where hands or feet are involved in the gangrene, the surgeon should assist nature's processes by amputation above or about the line of demarcation, as soon as indicated.

In senile gangrene.

In "senile gangrene" the interference should be of the mildest kind, but when a limb dies from embolic plugging, occlusion of an artery, or from the effects of ergot of rye, amputation may be performed as soon as the line of demarcation has been indicated, that is, provided the general condition of the patient be such as not to forbid it.

Where "sphacelus" takes place after the application of a ligature to

a large artery, early amputation is sometimes called for, it being at times wise to remove the limb above the line of ligature (after ligature of artery) rather than to wait for nature to indicate the point, particularly when the limb is œdematous from blood stasis and infiltrated with inflammatory products; this practice under these circumstances saving much constitutional disturbance and economising power. In cases, however, in which the gangrene assumes the anæmic form and spreads slowly, a line of demarcation may be waited for, more particularly when the constitutional condition of the patient is good.

Treatment of static gangrene.

In the treatment of the third group of cases, those of "static gangrene," caused by the mechanical obstruction to the return of blood from a part, the first thing to be done is to remove the cause. In hernia this is accomplished by dividing the stricture, in paraphymosis by freeing the prepuce, and when it is the result of the application of a tourniquet or splints, by their removal, and so on. By this course, if the parts involved are not irreparably lost, a recovery may take place by natural processes, their venous circulation being aided by position and other means. When gangrene, however, has taken place in a limb from this cause, its early amputation is necessary, it being wiser to remove the dead part at once before the setting in of secondary inflammation which may spread and cause more loss of tissue; the seat of the mechanical force fairly indicating the extent of mischief.

In gangrene of a limb from a ruptured artery or aneurism, the same practice should be resorted to for similar reasons; delay, under all these circumstances, being unnecessary as well as injurious.

HOSPITAL GANGRENE,

Causes.

or sloughing phagedæna, is an affection that attacks wounded or injured parts, and chiefly in over-crowded, badly ventilated, or ill-drained hospitals. At times it presents itself as if generated in a ward too closely filled with patients who have suppurating wounds; at others, as if conveyed into a ward by the introduction of a sloughing or fœtid sore. Want of cleanliness in the treatment of suppurating wounds and want of attention to sanitary laws have undoubtedly much to do with its propagation, for the disease seems to be contagious as well as infectious, through its discharges. Its contagious character is admitted by all, though some dispute its infectiousness. Guthrie, however, in his 'Commentaries,' relates the following striking fact bearing upon the point:—"Burgmans says, that hospital gangrene prevailed in one of the low wards at Leyden, in 1798, whilst the ward above it was free. The surgeon made an opening in the ceiling between the two, in order to ventilate the lower or affected ward, and, in thirty hours, three patients, who lay next the opening, were attacked by the disease, which soon spread through the whole ward."

Two forms: *a.* Ulceration.

Two forms of the disease exist. In one the ulcerative action is the more violent, wounds attacked with it rapidly spreading; skin, subcutaneous and connective tissues all disappear under its action, small sloughs taking place at the same time. Blackadder relates how a vesicle forms and ulcerates, the ulceration rapidly spreading, leaving a sharp well-defined edge to the ulcer. This form of the affection Delpech designated "ulcerous," and Boggie "phagedæna gangrenosa."

b. Sloughing.

In the second form the tissues die in masses, forming pale, ash-

coloured, pultaceous, horribly offensive sloughs; these sloughs giving the old term "putrid degeneration" to the disease. In one epidemic the ulcerative form will predominate, in another the sloughing, and, at times, it appears as if one form of the disease would give place to the other.

As a rule, though not always, an open wound seems requisite for the disease to fix upon. In 1849, when the wards of Guy's Hospital were *last* filled with such cases, a contused part often took on the action, the affection commencing as a vesicle the base of which turned at once into a greyish slough, which rapidly extended. When it attacked a wound, the edges or surface would cease to secrete, but assumed a grey colour, and as a slough, would spread, small wounds enlarging even in twenty-four hours. When the slough had ceased to spread, ulceration would begin to throw it off; and the fœtor of the slough, with the *débris* of the ulcerating tissues, formed a mass of decomposing material unequalled in any other affection. Skin readily died under the influence of the process on the connective tissue; but muscles became likewise involved; tendons and vessels gave way only in prolonged cases, and hæmorrhage was rare. The parts around the wound showed small signs of change till the sloughing had ceased and ulceration had commenced, when the line of separation would be indicated by a red zone.

Characters.

Local conditions.

The constitutional symptoms of the disease in the epidemic I have witnessed, were absent at the outset, and there was certainly neither fever nor other disturbance to indicate the approach of the action; yet when the local disease had once manifested itself, great depression became very general. It was always remarked, however, that the constitutional symptoms were never in proportion to the extent of the local affection. When strong subjects were attacked the local mischief told but little upon their powers; while with feeble subjects the effects were more marked.

Constitutional symptoms.

Military surgeons, however, have related that the constitutional often preceded the local symptoms. Hennan states this very clearly; and Thomson, of America, found a like result; while Blackadder, Delpech, Guthrie, and Macleod, found the local affection took precedence in point of time.

It would rather appear from the descriptions given of the epidemic at various times, that the ulcerative form is more commonly preceded by constitutional symptoms than the sloughing—the sloughing being, apparently, a local affection at the first.

During the late German campaign Professor Billroth met with a wound disease, which he had not seen before, and which he terms "diphtheritic phlegmon," or "diphtheritic infiltration." He describes three cases in which the diphtheritic appearance occurred soon after operations, and was speedily followed by fatal collapse. The entire muscular structure of the part became hard and stiff, from an indurated infiltration, the surface of the wound being of a pale grey. The affection was especially distinguished from gangrene by an absence of any rapid increase of the ulcerative process or of inflammatory redness in the vicinity; the surface of the wound exhibiting a lardaceous whiteness, and not the greasy pulpiness of hospital gangrene. The broad, hard infiltration so soon following the operation, might seem to be due to contagion, by means of the dressings employed, but this was scarcely probable. In its sporadic form it especially appears

Billroth on diphtheritic infiltration.

to affect the subjects of septic or pyæmic disease, and perhaps, certain conditions of the secretions inclined to coagulation may favour its production.

Treatment of hospital gangrene.

Treatment.—*Abundance of fresh air* is most essential, even to an air bath, as maintained by a constant current allowed to pass through the ward or room; isolation, the free use of such antiseptics as may be preferred, and close attention to all sanitary measures should be scrupulously observed. During the early stages of the disease irrigation seems to be the best local treatment. *Sponges should never be employed.* The next object should be *to take away all sloughs and putrescent material*, and this must be done by carefully cutting the existing slough with scissors or scalpel aided by the dressing forceps, and mopping the surface of the wound with cotton wool or tow, thus *thoroughly cleansing the whole surface of the wound.* The third aim is local applications to prevent the extension or return of the sloughing.

Local measures.

Of these applications nitric acid was formerly the chief, the acid being freely applied to the diseased parts, and carefully introduced into every hollow and excavation into which it could percolate.

To apply the acid, writes Welbank, "the sore must be thoroughly cleansed, and all its moisture absorbed by lint or tow. The surrounding parts must next be defended with a thick layer of ointment; then a thick pledget of lint, which may be conveniently fastened to the end of a stick, is to be imbued with the acid, and to be pressed steadily on every part of the diseased surface till the latter is converted into a dry, firm, and insensible mass. The part may then be covered with simple dressings and cloths wet with cold water."

Dr. Goldsmith, of America, has spoken very highly of the value of bromine as an application, which arrests ulceration and turns sloughs into tough deodorized tissues. Others also, have adduced sufficient evidence to prove its value. It should be applied freely, as is the nitric acid, to the whole surface, its application being repeated when the sloughing or ulceration spreads. Iodine and the oil of turpentine have also been advocated, the latter, it is said, has the power to dissolve the sloughs and change the action of the disease. Delpech and some surgeons speak highly of the actual cautery, and when the galvanic cautery is to be had, it should be used—the object of all these different plans of treatment being to excite a new action on the surface of the wound, and to destroy the sloughing tissues which, doubtless, by mere contact, have a power of keeping up or propagating the disease.

When the sore is extensive, an anæsthetic should be administered during this local treatment. After the cauterization, the surface of the sore should be dressed with the permanganate of potash, carbolic acid, or iodine lotion; opium should be added to allay pain; bromine in solution, two drops to the ounce of water, is also beneficial.

Dr. Packard of Philadelphia, prefers the use of powdered sugar or thick syrup, sugar being a hydrate of carbon which does not give up its oxygen and well known for its preservative powers in the case of meats. He dusted the parts with the sugar, and covered the whole with wet lint. When odour exists charcoal should be mixed with the sugar.

Constitutional treatment.

The constitutional treatment consists in abundance of light nutritious food, milk being administered as freely as it can be taken, with

sufficient stimulants to maintain the circulatory system and assist digestion.

Tonics, such as quinine and iron, are often well borne in large doses, five grains of the former dissolved in half a drachm of the tincture of the perchloride of iron being a good recipe, or, when quinine cannot be taken, the tincture of nux vomica in ten-drop doses may be substituted.

Opium is an admirable drug when the ulcerative action is present, but in the sloughing stage it is not so satisfactory. It may be given in any of its forms. Chloral is probably a good remedy for a like purpose.

ERYSIPELAS.

Definition.

ERYSIPELAS is a specific disease due to the presence of some blood poison that has probably been introduced into the body from without. It is intimately allied with other blood poisons, such as are found in scarlet or puerperal fevers, or septicæmia in any of its forms; for these poisons seem to be convertible. It is not so much an hospital disease as is generally believed, only 172 cases having taken place in Guy's Hospital in the five years ending with 1876 out of 9255 surgical patients which were admitted, or 1·85 per cent. No less than 253 cases were however admitted *with* the affection, and some of those recorded as having been transferred from one of the wards, simply passed through it.

Not hospital disease.

Varieties.

It manifests its presence in three forms:—As a diffused cutaneous inflammation, "simple cutaneous erysipelas;" as a diffused inflammation of the cellular tissue, "diffused cellular inflammation;" and as a diffused inflammation of both skin and cellular tissue combined, "phlegmonous erysipelas;" the two latter being included in the expression "cellulo-cutaneous." The state of the system, the temperament and habits of the individual, have much to do in determining the form of the affection. When the disease follows an injury, it is called "traumatic;" when it occurs spontaneously, it is styled "idiopathic."

Its essential characters.

The peculiarity of erysipelas lies in the diffused character of the inflammation and in its atonic nature. It is both *infectious* and *contagious*.

Symptoms.

a. Constitutional.

The attack is occasionally preceded by some constitutional disturbance, but as often as not such has not been observed; the severity of the general symptoms, moreover, in no way bear any proportion to that of the local disease. Febrile symptoms ushered in by chilliness and *rigor*, are the most common, the tongue being probably a foul one, and the bowels constipated or relaxed. As the disease advances the fever runs high; delirium of different forms appear and the pulse becomes quickened; but if full, it will always be compressible, and often irregular or intermittent. Towards the close of the disease, particularly when terminating unfavorably, the pulse will be small and weak. The temperature at the first onset of this disease as a rule rises rapidly, and, in its decline, falls as fast (*vide* figs. 4 and 5). When the temperature remains high, a bad prognosis should be given.

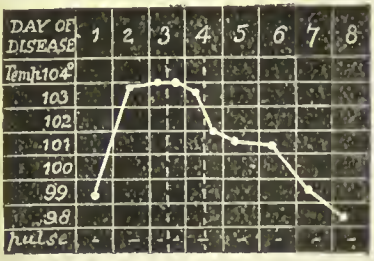
C. de Morgan, Nunneley, and H. Bird assert, that if the pulse rise in frequency after the sixth or seventh day it is a very bad sign. I cannot, however, endorse this observation, although, as the end of the first

week is about the time that complications appear if they occur at all, it may possibly be correct.

Premonitory affection of cervical glands.

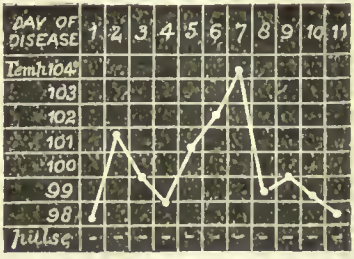
Frank has pointed out that when a patient has had febrile symptoms for some hours attended with pain, tenderness and swelling of the

Fig. 4.



Thermograph of erysipelas supervening upon removal of the tarsal bones after the traumatic temperature had subsided, showing rapid elevation of temperature—nearly 5 degrees—at the onset of the disease and steady fall during convalescence. Case of H. B., æt. 32.

Fig. 5.



Thermograph of erysipelas in man, æt. 29, after removal of parotid tumour. Operation (day 1) followed by slight traumatic fever, day 2, and steady fall in temperature. Elevation of temperature, day 4, when blush first became visible, and steady rise for three days during increase of disease with rapid fall on its subsidence. Convalescence on 11th day.

lymphatic glands of the neck, there is no doubt that erysipelas is coming on. Chomel held the same view, and Campbell de Morgan relates "that Busk is so convinced of the invariable occurrence of affection of the glands before erysipelas appears, as to consider it a pathognomonic symptom," and he believes that, although the blood became affected, the actual primary seat of the local inflammation was in the absorbent system. Sometimes swelling and excessive tenderness of the glands precede by many hours the appearance of a blush on the skin. These views accord well with those which Dr. Bastian brought before the Pathological Society in 1869, based on the post-mortem examination of a man who died from erysipelas in a state of delirium and stupor. In this case finding the small arteries and capillaries of the brain plugged with embolic masses of white blood-corpuseles, he suggested this condition as the cause of the delirium. He stated "that the blood change is a general one, and through every part of the body this blood is carried with its rebellious white corpuscles, so that we may expect that in all organs alike the same obliterations of small arteries and capillaries take place." Thus, when those of the liver are involved, jaundice may be produced, and when those of the kidney, albuminuria, these conditions being occasionally found in erysipelas.

Dr. Bastian's views.

Capillary embolism.

If we accept Dr. Bastian's observations pathologically, and look to the condition of the white blood-corpuscles for an explanation of many of the phenomena of erysipelas, we may fairly admit the inference from clinical observations respecting the absorbent system to which Frank and Busk have called our attention, for the glands of this system and the white blood-corpuscles are generally recognised as having a close relationship. All these observations, however, require confirmation.

b. Local symptoms.

Local symptoms.

In mild form.

In the *simple* form of cutaneous erysipelas, mere excess of vascularity as indicated by the vivid redness of the part affected, is the one local symptom; this redness rapidly spreads. A sensation of heat or tingling in the part, and, in rare instances, small vesications may be present. On pressure the redness will disappear, to return directly the pressnre is removed, bnt there will he no pitting of the parts to indicate œdema. In a day or two these symptoms will snhside or disappear, the cuticle desqnamating.

In severer form.

In the more severe form of cutaneons erysipelas, the vascnlarity of the skin will be as intense as in the simple, but it may be more livid. It will be associated with some perceptible thickening of the parts—the inflamed tissues feeling raised on palpation. This inflammation will spread rapidly in one or other direction, sometimes occurring in patches, and these patches joining. Where much cellular tissue exists, œdema will rapidly show itself, as in the eyelids or scrotum. Small or large vesicles form on the snrface containing either a clear serum or a blood-stained or sero-purulent fluid, the latter form indicating great depression.

In the head or other parts where the skin is tight, the feeling of tension is very great and the surface looks shining, the featnres being altogether obliterated. There is rarely, however, much pain. The border of inflammation is invariably well defined.

Course and duration.

The disease runs its course in about ten days. During the first three or four it spreads, and, having reached its height, declines, the redness and swelling gradually snbsiding and the skin desqnamating. In some cases a local suppnration takes place, and this is always to be suspected when any local redness remains after the snbsidence of the inflammation. In the eyelids and other parts contaiuing loose cellular tissue such a result is common. In the cachectic subject the disease is always more œdematous than in the healthy. When it attacks a wound the general symptoms are the same, bnt the local consist in arrest of secretion in the part, and then nlceration. Where union has existed, disunion appears, stumps and wounds sometimes reopening and discharging a thin ichorous fluid.

After the disease has subsided, repair is usually slow, but at times, it goes on healthily to complete recovery.

Prognosis.

Simple erysipelas, unless in the feeble or cachectic, is rarely a disease of much danger. When it attacks the scalp after head injuries it is exceptional to find it followed by bad conseqnences. In free living snbjects, and in others who have bad viscera, it is a dangerous affection, lighting up latent disease that often proves fatal.

Where the erysipelas attacks the mucons lining of the throat, fauces, or larynx, it may from mechanical causes, threaten life.

In some cases the disease will affect different parts of the body consecutively, or leave one spot to attack suddenly another. Such cases usnally indicate want of power, and too often are fonnd in those who have some organic disease of the kidney or other excretory organ.

On diffused cellular inflammation as a form of erysipelas.

Diffuse cellular inflammation may clinically be looked upon as a form of erysipelas, the disease attacking primarily the cellular tissue instead of the skin. It is characterised by the same diffused form of inflammation and by the same atonic character. It is, however, more frequently the result of some local injury such as a punctured or dissec-

tion wound than is the simple form, and it is even found in patients from whom no such history can be obtained It is generally associated with absorbent inflammation and glandular enlargement.

Local symptoms.

The disease appears as a diffused swelling and induration of the cellular tissue of the part affected, the tissues feeling infiltrated and brawny, and the skin tense from over-distension. When suppuration or sloughing of the cellular tissue has taken place, fluctuation or crepitation will be detected or the parts feel boggy. The skin, if not previously inflamed, will now participate in the disease; it will inflame, ulcerate or slough, to permit the escape of the pent-up pus or sloughing cellular tissue. When resolution takes place at an early period of this affection, the skin may escape uninjured, but such a result is rare.

Constitutional.

The constitutional symptoms attending these changes in the cellular tissue are always those of great depression. The febrile symptoms will be of the typhoid type, the pulse feeble from the first although rapid, and the disposition to sink very marked. Profuse sweating is an early and constant symptom. Delirium also is sometimes present. Visceral complications are, as a rule, the cause of death, the connection between this affection and pyæmia being very close.

On phlegmonous erysipelas.

Phlegmonous erysipelas is a combination of the two former. It is far more serious than the simple, and as much so as the cellular inflammation. It is characterised by a diffused inflammation of the skin and cellular tissue together, the parts having a strong disposition to suppurate and slough. Resolution is almost unknown as a termination of the disease, one case differing from another only in the extent of the destruction of tissue with which it is accompanied. It is commonly the result of some punctured wound or injury involving the skin and cellular tissue beneath, and begins locally as a brawny infiltration of a part, the skin presenting erysipelatous redness, of a dusky hue. To the finger the parts will feel more solid, and pit on pressure; the boundary between the inflamed and uninflamed skin will be less marked, and outside the limit of the redness the skin will feel unnaturally firm, and the cellular tissue beneath as if infiltrated.

Local symptoms.

Progress of phlegmonous erysipelas.

As the disease progresses, and the cellular tissue beneath the integument becomes infiltrated with inflammatory products, the skin will be made tense, and cease to pit on pressure; uniform hardness of the tissues giving place to a sense of fluctuation, as of fluid, or to a boggy, quaggy, crepitating feel of sloughing cellular tissue.

Sloughing of tissues.

If the case be left to nature, the skin will become thin and ulcerate in parts or slough in masses, to give way to the pent-up and sloughing tissues. Phlyctænæ appear over the dead portions of skin as in other forms of gangrene, while the pus and sloughs which escape are always fœtid. In bad cases the whole cellular tissue of a limb, with large portions of integument, may die in this way; bands of skin, held down by fascia, being commonly felt, which, during recovery, will become the centres of cutification.

In the ordinary run of cases this diffused infiltration of the cellular tissue is confined by the fascia to the subcutaneous tissue; but in some instances, when the cellular tissue that separates the muscles becomes involved, the case assumes a far more serious aspect, for the suppuration is then of a burrowing kind, the sloughing more extensive, and the prospect of recovery, with an useful muscle, becomes very

slender, because muscles and tendons may not only slough wholly or in part, but on recovery taking place, they become so closely bound together with all the other tissues that they are useless as moving organs. From this cause, after phlegmonous inflammation of the hand and forearm, a stiff and immovable extremity is often met with, the hand becoming a kind of fin.

Severity of constitutional symptoms.

The constitutional symptoms attending phlegmonous erysipelas vary considerably; their severity depends much upon the rapidity with which the disease spreads. They are, however, in character the same as are to be found in other forms of the affection, though probably more severe. The rigors are more marked, the fever higher, the pulse more rapid, and the tendency to fall in power always marked. Thus, in the second stage of the disease—the suppurative or sloughing—the rigors frequently recur; cold sweats and fever intervene as in an ague, these attacks being indicative of suppuration. When the local affection is undergoing repair, or, at any rate, has ceased to spread, and these "false ague fits" persist, some internal or visceral complication may be looked for, as the blood becomes poisoned as in septicæmia, and often to the extent of destroying life.

Pathological appearances found in erysipelas.

The pathological appearances met with in cases of death from erysipelas have been kindly drawn up for me by Dr. J. F. Goodhart, after a careful analysis of the post-mortem records of the hospital. They admit of being classified as *local* and *general*, the former including all those morbid changes which occur in the primary focus and in the surrounding parts directly extending from it; the latter, the various alterations of blood or tissue found in any secondary foci or in the system at large.

Local.

The *local* changes vary according to the severity of the disease and the rapidity with which it causes death.

In the slighter forms, where it has not been the immediate cause, but has supervened as an intercurrent affection in the course of some other disease, it may often happen that no morbid appearance is visible post-mortem indicating erysipelas. Again, the skin alone may be affected either with a mere faint purple discoloration or with slight œdema, or, the the cuticle may be raised into bullæ or separated more or less around. In more pronounced cases, the areolar tissue beneath the skin and along the tendons and intermuscular septa has numerous minute ecchymoses and extravasations of blood in it, and is often soaked with yellow serum or gelatinous matter, apparently produced by a delicate fibrinous coagulum; in the more prolonged or in severe cases, the serum is replaced by good-looking pus. Ecchymoses in the subcutaneous areolar tissue are very common even in cases where death has been very rapid and no other morbid appearances are seen.

It is characteristic of the further changes that there is no tendency to the limitation of the disease around the primary focus; the pus or serum leads to the formation of no abscess sac, but spreads along the subcutaneous tissues and intermuscular septa, sometimes even making a complete dissection of some of the muscles.

There may or may not be phlebitis in the parts. Where it exists, the interior of the veins affected is discoloured and filled with a grumous chocolate-coloured fluid, while the inner surface of the vein wall is rough from the inflammatory processes it has undergone and the adhesion

of small particles of clot. Where the disease has existed some time a tube of semi-organized clot may line the vein, and within that will be found the broken-down clot which it is often impossible, microscopically, to distinguish from pus. Local.

It is quite as common, if not more so, however, to find the vessels unaffected as to find them plugged. Pus may even run along their course, sometimes apparently in their adventitia, but generally immediately outside it, and still lead to no clotting. On microscopical examination in these cases the pus is seen to lie in smooth-walled channels which in all probability are lymphatic spaces (suppurative lymphangitis).

The neighbouring lymphatic glands, *i. e.* those in the groin if the disease be situated in the leg—the axillary, if in the arm,—are usually swollen, red, and ecchymosed on section, and are frequently surrounded by the same kind of serous fluid as is found in the immediate neighbourhood of the primarily diseased tissue. The tissues of all the diseased parts are said to be crowded with small vegetable organisms called bacteria. These constitute the local changes. It may be as well to add, perhaps, when erysipelas affects the scalp, that a yellow colour of the vault of the skull is often observed, and also that suppuration between the bone and dura mater and suppurative arachnitis and meningitis are not very unusual sequences. About the neck it may be followed by œdema glottidis, and occasionally by pericarditis or suppurative inflammation of the mediastinum.

The morbid appearances in the system at large are similar to those found in septicæmia from other causes, viz., ecchymoses about the pleura and pericardium; a fluid and sometimes treacly state of the blood, congested kidneys, and a softened state of the liver and spleen. So soft, indeed, is the latter organ that were it not for its capsule it would at times lose all shape. The blood has been said to contain bacteria, but I have never found such during life, though they are sometimes present when the blood is examined some hours after death. In addition to these *general* changes, separate foci of diffuse cellulitis are found—in both forearms and in the calf of the leg, for instance, after a primary erysipelatous state of the scrotum—and in at least two recorded cases a similar diffuse cellulitis or myocarditis has been noticed in the muscular wall of the heart. Patients with erysipelas are also liable to suppurative peritonitis and pleurisy, which, though commonly so, are not necessarily determined by the presence of a neighbouring wound. A subject of hernia or ovariotomy at a time when erysipelas is rife will be likely enough to die of suppurative peritonitis; while another who has undergone an excision of the breast may die of a similar form of pleurisy without showing any external evidence of erysipelas. General. Bacteria.

A wound, however, is not necessary, For example, in a post-mortem made not long since, a lady about sixty had been nursing a friend who died of some febrile affection called "low fever." Within a few days she herself became exceedingly ill and died quickly. The inspection revealed what had only been evidenced by the faintest blush on the skin during life—viz. an early suppurative inflammation of the cellular tissue of the right axilla and pectoral region, and pus on the surfaces of both pleuræ; all this without any external wound whatever.

As occasional causes of death in erysipelas may also be mentioned acute lobar pneumonia, and a diphtheritic sloughing of the mucous co

of parts of the bowel; while to complete the history, it must also be said that at times when erysipelas is present in an hospital or its neighbourhood, not only are cases of pyæmia with the known manifestations frequent, such as abscesses in the viscera and pus in the joints; but patients suffering from chronic suppuration become feverish and die without, it may be, any adequate cause appearing in the viscera.

In this description of the pathological appearances found in erysipelas no attempt is made to distinguish between it and cellulitis. The morbid changes in both are the same, and it is as impossible in the deadhouse as at the bedside to separate the two.

Treatment of erysipelas.

TREATMENT.—The disease in all its forms being essentially an *atonic* one, nothing like "antiphlogistic" remedies are to be entertained, and in the simpler forms which have a tendency to run a definite course,

Support the powers.

the practitioner has merely to guide his patient through the attack, and to ward off whatever might prove injurious. With these objects when the patient's powers are good, and no indications of feebleness manifest themselves, a mild aperient or purge, to clear out the bowels, with bland nutritious food, such as milk and beef tea, are probably sufficient remedial means; the disease, on the third or fourth day, attaining its height, and then declining.

Tonics.

Should any feebleness or want of power appear at the beginning or during the course of the disease, tonics are indicated, and of these iron seems the best. The tincture of the perchloride in half-drachm doses, or more to an adult frequently repeated, with or without quinine or strychnia, acts at times like a charm. Its use was introduced to British surgeons by Dr. H. Bell, of Edinburgh in 1851, and stands unrivalled, although Velpeau, in 1841, had previously declared its value. It doubtless often cuts short the disease.

In the earliest stage of the affection, when the first patch of inflammation appears on the skin or around a wound, an emetic may at times abruptly check the attack.

Stimulants.

When food cannot be taken, stimulants must be substituted, and it is often possible to introduce into them, and particularly into stout, some essence of meat. The form of stimulant must depend upon circumstances, but, as a rule, that which the patient has been in the habit of taking is the best. When brandy is given it should be mixed with milk or eggs, it being always better not to give stimulants alone. The amount must be regulated with care, for over-excitation of the system is always bad.

Sedatives with caution.

Hypnotics or sedatives should be used with caution, for they are not usually beneficial. Of these, chloral seems less liable to disagree than opium; camphor and henbane in five-grain doses, are thought well of by some, while ammonia is as highly recommended by others.

In phlegmonous and cellular erysipelas the same principles of practice are applicable. In the suppurative or sloughing stages it is necessary to give abundance of good food of all kinds, and stimulants in proportion; strong animal broths and milk are the best forms of diet.

Local treatment of erysipelas.

LOCAL TREATMENT.—The inflamed parts should always be kept warm and raised, air being excluded from the surface; consequently, when the head and face are implicated with simple erysipelas, the old practice of flouring the parts is effective. Warm fomentations, however,

where they can be applied, are the best, especially when medicated with poppy, hop, or chamomile. Cold applications are injurious. In simple form.

In the face and head, when the parts are very tense and painful, relief is readily given by following the practice of Sir R. Dobson in puncturing the skin with a series of small punctures—oozing of blood or serum being encouraged by warm applications.

Mr. Luke thought highly of the free use of collodion, applied over the part; Mr. Norris, of the compound tincture of iodine; Mr. Higginbottom, of a solution of nitrate of silver, twenty grains to the drachm of water; others, of the sulphate of iron a drachm to a pint. The tincture of the perchloride of iron has also been recommended for the same purpose. I have employed at times all these, likewise a mixture of iron and glycerine, but none of them have any certain power of arresting the progress of the disease; in some cases success seems to attend their use, but in others they appear valueless. Some American surgeons speak strongly in favour of the application of a solution of bromine on lint, with oil-silk over the whole; and quite recently the subcutaneous injection of a solution of carbolic acid has been highly spoken of. Mr. De Morgan believes there are not many things more comforting to the patient than a thick layer of cotton wool placed over the part, to which powder or collodion has been applied.

The local treatment of the cellulo-cutaneous forms of the disease must be conducted on the same principles as the simple, but as soon as anything like tension of the integument appears—this tension being clearly caused by the presence of inflammatory exudation in the sub-cutaneous tissue—incisions should be made deep enough to allow of the escape of the effused serum from the cellular tissue beneath the skin, and long enough to relieve the tension of the whole. Some, and amongst them the late Sir W. Lawrence, recommended the incision to be free, so as to extend the whole length of the affected part. Others, among whom I claim a place, prefer a greater number of limited incisions. These limited incisions answer the same purpose as the long, and are not attended with so copious a hæmorrhage, or with so great a risk to life. Even after these the bleeding is at times profuse, but it may generally be readily arrested by elevating the limb and by temporary pressure. Local treatment of cellulo-cutaneous form. Incisions.

When suppuration and sloughing exist the surgeon must let out all matter as soon as formed, for there is little doubt that the disease is kept up by its presence. The opening into these abscesses should be free, and their cavities kept clean by careful washing out at each dressing, a detail which adds materially to the comfort of the patient and the well-doing of the case. Condy's fluid or iodine lotion should be employed. De Morgan prefers a solution of chloride of zinc, fifteen grains to the ounce. Water dressings should be applied to the parts, and frequently changed, a warm fomentation over the lint being often useful. Poultices are not so good, although at times patients say they derive the most comfort from them. During the period of repair the surgeon will often have to lay open sinuses. When the sloughing has been very severe amputation may be called for. Relieve suppuration.

It has ever to be borne in mind that erysipelas is highly contagious and infectious. In hospital practice, consequently, every case, as it arises, should be separated from others in which wounds exist, and transferred Avoid communicating the infection.

to a separate ward. All dressings and towels as they leave the ward or chamber should be burnt or disinfected; and a sponge should never be used. Plenty of fresh air ought to be admitted into the room, but no draught; and disinfectants should be freely distributed about. No medical practitioner under any circumstances should go direct from a case of erysipelas to a midwifery case, or to dress a wound of any sort, accidental or surgical. If he is obliged to attend a labour when in charge of such a case, he should allow as much time as possible to intervene before doing so, and then should attend only after having changed his clothes and carefully disinfected his hands, for there is a direct connection between erysipelas and puerperal fever.

Isolation and fresh air.

ERYTHEMA.

Erythema.

Erythema finds its place here, as in its clinical features it bears some resemblance to the simple cutaneous erysipelas, and has been mistaken for it. It appears as a roseate or more vivid injection of the skin, of a local or general character, disappearing on pressure, and accompanied with some slight degree of œdematous swelling.

When transitory.

In its mere *transitory* form, when it appears as a cutaneous hyperæmia, it may be regarded as a symptom of some bowel or intestinal irritation, induced by irregularity in diet, or other cause. In so-called bilious subjects it is by no means uncommon, a local patch of redness on some part of the face, or other part of the body, often indicating the approach of a "bilious attack." It is found, also, where organic disease of the intestines is present. In other cases it precedes an attack of smallpox, attends vaccinia, and is common in children.

Hebra gives the term *erythema fugax* to all these symptomatic forms of erythema.

Erythema as a disease.

Erythema, as a *disease*, more commonly attacks the extremities than the trunk, and the dorsal surfaces in preference to other parts. When the efflorescence appears in small patches of papules or tubercles upon the fingers or hands, the terms *E. papulatum* and *E. tuberculatum* are respectively given.

Varieties.

When these patches assume the form of a red ring, the term *E. annulare* is applied to it. When a second ring forms round the first, before it has passed away, or when it is represented by a small spot, the *E. iris* is formed; and where many such circles or half-circles appear together, and touch or coalesce and spread, the *E. circinatum* and *E. gyratum* are respectively present. Wilson mentions a case in which the *E. gyratum* covered the whole body; but all these different forms of erythema must be regarded as different stages of the same disease. Hebra says, "it will depend on the period at which the patient comes under medical observation whether the case shall be diagnosed as *E. papulatum* or *E. gyratum.*" He gives one term to the whole, *E. multiforme.* As the disease subsides, a slight desquamation follows, and then some small deposit of pigment. Mr. Morrant Baker describes an *Erythema serpens* which follows a slight, probably poisoned abrasion, and spreads in a circular manner, leaving the injured part well. It generally occurs in the hand. ('St. Barthol. Hosp. Rep.,' vol. ix.)

Wilson and Hebra on erythema.

Treatment.

All these forms run a definite course, and have a tendency to get well, lasting from one to three or four weeks. They require for

treatment little else than a well-selected diet and attention to the bowels.

Erythema occurs at times during the secondary stage of cholera.

The erythema that precedes or accompanies an attack of elephantiasis is worthy of notice.

Erythema nodosum.

Erythema nodosum, however, is a more definite affection; it is found in both sexes, but more commonly in the female; it is also usually seen upon the legs, but not rarely upon the arms as well as other parts of the body. It shows itself in raised and tender oval patches of very variable size, and of a red colour; some being the size of a sixpence, others that of an orange, and these patches at times join. At first they are of a bright red colour, but as they die away they become of a livid hue, appear very like bruises, and lastly are of a yellow tint. The cuticle always desquamates. When the disease is limited there may be no constitutional disturbance, although occasionally some febrile symptoms appear, and there is usually some evidence of derangement of the digestive organs with a foul tongue. As often as not, however, the local disease is the first symptom that attracts attention. The eruption is often symmetrical. When it appears over the tibia and the skin is very red and painful, it is often mistaken for some more serious affection, such as periostitis; but the absence of the severe constitutional disturbance which commonly attends this affection, ought to prevent such an error. The history of the case is enough to distinguish it from a bruise; and the different centres of redness or congestion from erysipelas.

Characters.

Treatment of erythema nodosum.

Its *treatment* is simple. Saline purgatives, tonics, and a carefully regulated diet are, as a rule, sufficient in a general way; and the application of a lead lotion to the inflamed part, with elevation of the limbs, is generally all the local treatment that is required; but in exceptional cases warm fomentations, with or without poppy decoction, give greater comfort.

ON TRAUMATIC FEVER, SEPTICÆMIA, AND PYÆMIA.

Definition.

Inflammatory fever, surgical, suppurative, or traumatic fever; septicæmia, ichoræmia, puerperal fever, and pyæmia, may all be considered as so many different names for, and manifestations of, one condition, viz. *blood poisoning.*

Infection from within.

In inflammatory and surgical fever "the returning fluids of the inflamed part, its venous blood, and its lymph, are the agents of general infection" (Simon), the poisoning being "due to the introduction into the torrent of the circulation of toxic substances produced by the organism itself" (Maisonneuve), the poison being probably derived from *disintegrated tissues and generated from within the body.*

From without.

In septicæmia, ichoræmia, puerperal fever, and pyæmia, the absorption of *putrid* inflammatory products, or of pus or pus-forming material, or of some other poison, whether from a wounded part or not, is the undoubted cause of the disease; *the poison being taken into the body,* either by the veins or by the absorbents from without. Traumatic or surgical fever may, however, pass into septicæmia, and this into pyæmia, the first being the mildest form of blood poisoning, the last the most

severe. Surgical fever generally ends in recovery, pyæmia after the formation of secondary abscesses, either in the viscera, joints or connective tissue, in death.

Symptoms of blood poisoning.

One and all are ushered in by very similar general symptoms, and an outline of those met with in a typical example of inflammatory fever will be found in a former page; "but practically the affection shows numberless grades and differences and complications. First, there are wide differences of degree and character, for in proportion as the local process is less acute and less extensive there is less attendant febrility; and in proportion as the local process has to invade fewer successive strata of texture, the fever is of shorter course. On the one hand, it may be so slight as readily to escape notice, and may end within a few hours of its commencement; on the other hand, it may last in full force during many successive days, and may be so severe as to shake the patient's life to its foundation; and, besides these differences, there are varieties of result, sometimes from complicative local conditions, sometimes from peculiar susceptibilities of the patient. If the wound become the seat of some large textural disorganization, with consequent soakage of putrefying material, more marked signs of *blood pollution* may be expected to mix with or supersede those of common inflammatory fever; the patient's general state will then incline to be one of depression and apathy; his tongue will be more than commonly foul, and fœtid diarrhœa will probably exist; or if, perchance, during the local process it happen (as is especially apt to be the case where cancellous bone-structure is affected) that pus passes up a vein into the general stream of blood, the patient's improvement is abruptly cut short by the *severe recurrent rigors and sweating of pyæmia*, accompanied by local signs of secondary suppuration in parts to which the pus is conveyed." (Simon.)

Its characteristics.

Confirmed blood-poisoning, therefore, is characterised not only by all the symptoms of inflammatory fever, but by *severe rigors* breaking in upon the febrile symptoms; by *sudden and marked variations of temperature* (*vide* fig. 6), by *profuse sweats and great depression of the patient's powers;* and when these symptoms occur in the course of an attack of inflammatory fever, severe blood poisoning is certainly indicated; the gravity of the attack being measured by the intensity of the symptoms. We generally meet, moreover, in pyæmia with local

Internal and external pyæmia.

signs of inflammation of some internal organ or external part of the body, and this inflammation runs on to the formation of *metastatic or secondary abscesses* as they are called. When an internal organ is involved in this disease the result as a rule is fatal. When suppuration attacks the integuments or extremities, although it may be severe, there is always some hope of recovery. It is an interesting clinical fact that these two different forms are rarely met with in the same subject. They may for clearness be separately called *internal* and *external* pyæmia, or *acute* or *chronic;* pyæmia, when involving internal parts, being generally rapid in its course and fatal; and when attacking external parts, it is as a rule chronic; at times, however, the latter may supervene upon the former variety.

In many cases of pyæmia a peculiar sweet hay-like odour of the breath is undoubtedly present. Some authors, and Braidwood is amongst them, look upon this symptom as pathognomonic.

Traumatic fever.

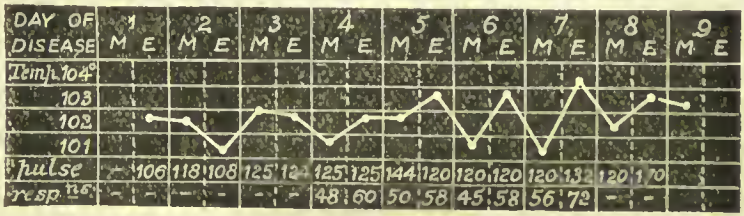
Traumatic fever, when it occurs, generally makes its appearance from

the second to the ninth day after an accident or operation, and seldom lasts over a week. In a simple case it may subside after twenty-four hours, and, in a severe one, it may continue for a week. When a *relapse*, or a second sudden rise of temperature takes place, grave mischief may be anticipated—some local inflammation, internal or external, being thus indicated. Billroth has described this second attack of fever as "secondary fever." When it runs on for a more lengthened period than a week severe complications are sure to exist to keep up the symptoms. During its course the temperature of the body, naturally 98·6° F., may rise suddenly 5° or 6° F., and in ordinary cases its fall is as a rule gradual; while with its fall defervescence takes place. Should the fall be sudden, a general breakdown of the powers of the patient is indicated, and under these circumstances sloughing of the wound may be expected. The rise of temperature is generally accompanied by an arrest of secretion or some change of action in the wound, but the fall of temperature indicates the on-coming of suppuration.

Rise of temperature.

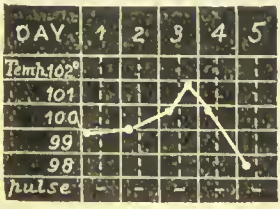
These points are well seen in the following thermographs, figs. 6, 7, 8, 9, and 10:

Fig. 6.



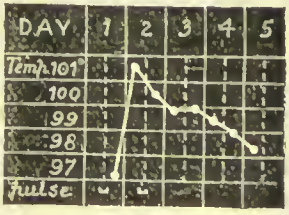
Thermograph of acute ostitis of the tibia in a boy, æt. 16, following a blow; admitted into Guy's on the fourteenth day with pyæmia which destroyed life on ninth day. The table well shows the fluctuation of temperature which is found in pyæmia with the night and morning variations.

Fig. 7.



Thermograph of traumatic fever, rise for three days, sudden fall, after amputation at hip-joint, in a boy æt. 9, terminating in recovery.

Fig. 8.



Thermograph of traumatic fever, sudden rise and steady fall after amputation of the leg for disease of foot in man, æt. 52, terminating in recovery.

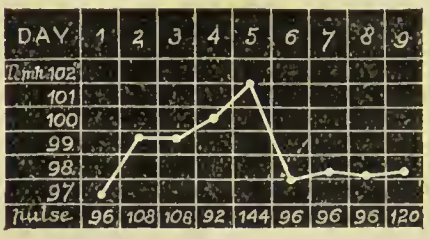
It is, however, important to know that traumatic fever is by no means a necessary consequence of an injury or operation, however severe; that it may follow a trivial injury or fail to follow a severe one; and that it is quite impossible to predict its occurrence under any circumstances. After a large number of capital operations it is entirely absent,—I should say after one third,—and since the practice of the torsion of arteries has been adopted and wounds have consequently been freed from the presence of such foreign bodies as ligatures, the number of cases in which it is absent has decidedly increased.

Traumatic fever not constant.

Arrest of secretion.

When blood poisoning attaeks a patient the subjeet of a wound, whether eaused by operation or injury, it is generally to be observed that the secretion of the wound beeomes sanious, serous, or fœtid; probably it will be arrested, and the surfaee will beeome glazed or glassy or perehanee assume a sloughiug action. The integument around the wound will often have an erythematous blush, or acquire a peeuliar leaden, dusky appearauee, whieh is somewhat typical. Union if progressing will eease or disunion may result. When any internal organ is implieated, speeial symptoms indicative of disturbanee of its functions will be present. When the *brain* is involved there will be sleeplessness or delirium of a low muttering kind, some unconsciousness from which the patient ean be roused only to relapse — "*relapsing unconsciousness*," — aud in rare cases aeute delirium and mania.

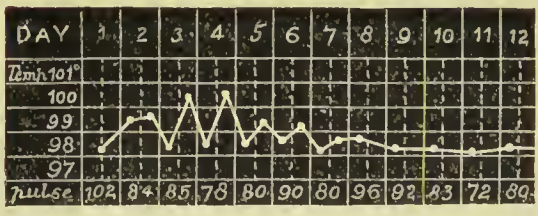
Fig. 9.



Thermograph of traumatic fever after operation for ruptured perinæum. Fever at its height on fifth day, when quill sutures were removed, after which there was a sudden fall and a steady convalescence. Patient æt. 45.

Brain complications.

Fig. 10.



Thermograph of traumatic fever after ovariotomy in a woman æt. 43, ending in recovery. Temperature never rose above 100.

Respiratory complications.

When the *respiratory organs* are involved—and it may be stated that they are so far more frequently than any other—difficulty of breathing, with a harsh dry eough, and perhaps viseid blood-stained sputum, are the promiuent symptoms; oeeasioually pleuritic paius are present, or symptoms of bronchitis, with great dyspnœa.

Abdominal complications.

When the *abdominal viscera* are affeeted, nausea or sickness is a prominent symptom, and profuse diarrhœa; the latter in some cases apparently earries off the poison. When anything like sallowuess of the skin or jaundiee appears, hepatic absecss should be suspected; and, under these eireumstanees, there will often be pain in the region of the liver. At the same time the reader must remember that a slight degree of jaundice is often present without hepatie suppuration. The urine is rarely altered either in eharacter or in quantity, although at times it is seanty and dark eoloured. When severe or dull pains are experieneed in a joint, suppuration should be suspeeted; and anything like so-called rheumatic pains oecurring in a patient with pyæmia beeomes a souree of suspicion; "rheumatic" paius in blood poisoniug too often meau joint or bone misehief of a suppurative kind. It is also remarkable how slight the symptoms often are in these eases when severe local disease exists. This fact demands that the surgeon should ever be on

Joint complications.

the watch to detect anything like local changes; inasmuch as it is a pathological truth that there is no organ or tissue of the body in which suppurative disease may not take place in a case of blood poisoning or pyæmia; and it is certainly true that the existence of severe local disease is too often only first discovered on the *post-mortem* table.

What then, it may be asked, are the *pathological conditions found after death* in a case of blood poisoning or pyæmia—using this word in a general sense? Pathological conditions.

The analysis (shown in the form of a table, page 58) of 203 fatal cases, which I have collected from the records of Guy's Hospital with the sanction of my colleagues Drs. Wilks and Moxon, by whom all the examinations were made, will answer this question.

Pathological Conditions from Pyæmia found after Death.

The lungs.—The most prominent fact indicated by this table has reference to the lungs, for it proves that in the larger proportion of fatal cases of blood poisoning these organs are implicated, and further, that in many they are the only parts involved. Lung mischief was found one hundred and eighty-seven times in two hundred and three cases; while in seventy-eight cases, or thirty-eight in every hundred, the lungs were the only organs affected. *Lobular pneumonia* is the form in which the disease is generally found; and when even a lobar pneumonia is present, it can usually be made out to have originated in lobules, and to have spread from them as centres. This lobular pneumonia, like the lobar form, is also generally seen in the *lower lobes*, and not at the apices; and nearer the surface than the central parts. The earliest indication of disease is a lobular pneumonia, and "subsequently," says Wilks, "these congested spots are found to contain inflammatory products, and thus we have red hepatization, suppuration or sloughing," all these stages of inflammation being visible in individual masses. Associated with this lobular pneumonia some *ecchymosis* of the surface of the lung will generally be found—a purpuric condition in fact—strongly suggestive of blood poisoning. Pleurisy, moreover, generally exists, the fact being accounted for by the superficial position of the lobular pneumonia. *a.* Lungs.

The liver, like the lungs, is also attacked in its lobules. These may be found only congested, or in any intermediate condition between this the first stage of inflammation, and the last, viz. that of suppuration, or sloughing. At times this organ is filled with small abscesses. When these abscesses approach the surface of the liver, they may burst and give rise to a general peritonitis. The liver was involved in this affection twenty-seven times in every hundred cases, and almost always in association with disease in the lungs. Thus, out of fifty-five cases in which the liver was affected, in only two were the lungs uninvolved. It would appear, likewise, from the table that the liver is more frequently the seat of pyæmic suppuration after injuries to the head than after any other affection, and that it is rarely found involved after disease of the urinary organs and burns. *b.* Liver.

The kidneys.—When these organs are affected, it is in the same manner as the lungs and liver, small isolated points of suppuration being found, surrounded by a zone of congestion either on their surface or in their cortical structure. They are not affected so frequently as are the two former organs—not oftener, indeed, than seventeen cases out of *c.* Kidneys.

Analysis of 203 Fatal Cases of Pyæmia.

Nature of accident or disease.	Number of cases.	Lungs.		Liver.		Kidneys.		Spleen.		Brain.		Heart.		Joints.		Cell-tissue.	
		Cases	Alone.[1]	Cases.	p. c.	Cases.	p. c.	Cases.	p. c.	Cases.	p. c.	Cases.	p. c.	Cases.	p. c.	Cases.	p. c.
Compound fracture	26	23	$11_{42\cdot3}$	9	34·6	3	11·5	1	3·8	—	—	—	—	4	15·3	3	11·5
Amputation after compound fracture	38	34	$14_{36\cdot9}$	15	39·4	2	5·2	6	15·7	—	—	—	—	4	10·5	3	7·8
Amputation for disease...	29	24	$14_{48\cdot2}$	6	20·6	2	6·9	2	6·9	2	6·9	—	—	2	6·9	4	13·8
Injury to scalp and skull	11	11	$1_{9\cdot}$	7	63·6	—	—	—	—	5	45·4	—	—	1	9·	2	18·1
Inflammation and suppuration of soft parts...	33	30	$9_{27\cdot}$	8	24·2	8	24·2	5	15·1	2	6·	5	15·1	8	24·2	5	15·1
Disease of urinary organs	22	22	$11_{50\cdot}$	—	—	10	45·4	—	—	1	4·5	1	4·5	—	—	1	4·5
Disease of bones and joints	28	27	$9_{32\cdot}$	6	21·4	8	28·5	4	14·2	—	—	4	14·2	6	21·4	2	7·1
Operations on soft parts..	5	5	$2_{40\cdot}$	1	20·	1	20·	1	20·	—	—	1	20·	—	—	1	20·
Carbuncle	6	5	$2_{33\cdot}$	3	50·	2	33·3	—	—	1	16·6	2	33·3				
Burns.....	5	5	$5_{100\cdot}$														
Total	203	186 or 91·6 per cent.	78 or 38·4 per cent.	55[2]	27·	36	17·7	19	9·3	11	5·4	13	6·4	25[3]	12·3	21	10·3

[1] In which the lungs were alone involved, with per cent. [2] Alone in two cases only, in all others lungs involved.
[3] Sterno-clavicular in eight.

every hundred. They are more frequently found involved after disease of the urinary organs than of any other, and after suppurative disease of the cellular tissue, particularly of that surrounding the shafts of bones.

In the *spleen*, large abscesses are often present. Suppuration may likewise be found in the *brain, heart, prostate, testis, tongue, thyroid gland*, and, in fact, in any portion of the body. In the cellular tissue of the trunk and extremities a diffused suppuration is very common, as it is also common in the joints. *d.* Other organs.

When inflammation attacks serous membranes, such as the pleura and peritoneum, there seems good reason to believe that it arises from the extension of disease from the lung, liver, or spleen; but in the joints no such extension can be made out. The sterno-clavicular articulation is more frequently involved than any other, for I find that out of the twenty-five instances in which joint complication existed, this was involved in eight Any joint may, however, be affected. In some cases the articulation is only filled with an increase of synovia, in others the contents are puriform—sometimes purulent. At times the pus in the joint appears to be so slightly irritating that the cartilage and the synovial membrane are uninjured by its presence, whilst at others it is so destructive as to produce complete disorganisation, the bones forming the joint being under these circumstances exposed, and at times necrotic. When these changes occur they are, probably, sometimes due to acute articular ostitis. *e.* Serous membranes. Joints.

The skin has occasionally a *vesicular* or *pustular eruption* upon it, and too frequently *purpuric spots* or patches are present, which at times lead on to mortification; and in connection with this subject "we may mention another evidence of the blood disease in the rapid decomposition of the bodies and the marking of the veins on the surface. Thus, before the body is scarcely cold, there may sometimes be seen the blue and red coursing of the veins and the colouring which has exuded from them into the tissues." (Wilks.) *f.* Skin.

Lastly, it is to be noted that it is exceptional to meet with any evidence of *phlebitis*, general or local; and this leads me to consider, although briefly, the now already abandoned and untenable theory that phlebitis, or inflammation of a vein, is the invariable cause of pyæmia. Inflammation of veins exceptional.

The most telling evidence against the theory is the one just mentioned, that it is only in exceptional cases of pyæmia that any evidence can be found of phlebitis; and the second is almost equally strong, because "so far from phlebitis being a cause of pyæmia, it is remarkable how often the former occurs without any contamination of the blood whatever; that is, if we can call that phlebitis where we find a vein and its branches quite closed by coagulum or adherent fibrin" (Wilks). Moreover, "it is a question whether, in those cases in which the veins are plugged or inflamed, thrombosis and phlebitis are not the local, and pyæmia the general effect of the same cause" (Savory)—that is, blood infection. With these views I cordially agree. Phlebitis not pyæmia.

That blood poisoning may take place through veins is certain, although, as I have already shown, inflammation of their coats does not necessarily lead to it; neither is it probable that the absorption of pus, as pus, is the usual cause; for when pus mixes with blood, coagulation is produced, and thus its circulation is prevented. There seems, however, good reason to believe that the fluid portion of pus or of some decomposing inflammatory product may be taken up by the veins and carried into

the system, and thus cause pyæmia. The poison may be imported into the general circulation through either a small or large vein, when involved in a suppurating or sloughing tissue; this is a frequent occurrence when the vein is connected with an inflamed or divided bone.

Theory of pyæmia.

It may, therefore, be fairly inferred that the *milder forms* of *blood poisoning* such as traumatic fever are caused by the circulation of morbid elements in the blood, which are generated either within the body or imported into it from without; and that these morbid elements are at times carried off, sometimes by the lungs, and at other times by the intestines: that the *more severe forms of blood poisoning*, as pyæmia, are caused by embolism—thrombosis, or blood extravasation, due to the admixture with the blood of some morbid fluid; and that this morbid material originates the changes which give rise to the secondary or metastatic abscesses with which surgeons and pathologists are so familiar. This view receives much support from the fact, that disintegrating fibrin may be carried from the heart through the arterial system into the smaller vessels of the parenchymatous organs, and give rise not only to constitutional symptoms much akin to those which have been described as being present in pyæmia, but to analogous pathological conditions. This condition is spoken of as arterial pyæmia. Thus in the more common form of pyæmia abscesses form in the viscera or other parts; and in "arterial pyæmia" lobular fibrinous changes occur. In the former case secondary abscesses are found after death, in the latter secondary fibrinous deposits; it seems probable also that at times these fibrinous deposits may break down and give rise to abscesses.

Embolism.

Arterial pyæmia.

This arterial pyæmia is met with after ulcerative and rheumatic endocarditis; it is, doubtless, the cause of the so-called rheumatic pains that follow scarlet fever; and in rarer instances it gives rise to the embolic plugging of some large vessel, which may be followed by gangrene, or by the formation of an aneurism. I have had to remove a leg on two occasions for gangrene from embolism of the femoral artery after scarlet fever, and have seen cases of aneurism which have probably been due to the same cause. (Vide 'Path. Soc. Trans.,' 1877.)

Arterial pyæmia is not necessarily fatal. Mild attacks come and go, says Wilks, "the proof being found eventually in the cicatrices and remnants of deposits met with in the organs of the bodies of those who have died with heart disease." The mild forms manifest themselves by pyrexia, prostration, and pains in the joints.

Hence, when a patient dies rapidly from blood poisoning, the only pathological change found in the tissues may be some lobular congestion of the lung, indicating the first stage of pneumonia; when life has lasted longer, red or grey hepatization may be present; and in a later stage lobular suppuration; these different conditions depending upon the intensity of the disease and its duration. "The first stage of the morbid condition which is produced in the viscera is a coagulation in the vessels, and the last stage is a suppuration." (Wilks.)

In feeble patients who have no resisting power against disease, it is possible that even these pathological conditions may not be found; life being, as it were, suddenly destroyed in the first onset of the blood-poisoning. Under these circumstances no definite post-mortem

appearances would be seen, beyond, perhaps, a general softening of the viscera, or some purpuric condition.

Duration of the disease.—There seems reason to believe that a patient may die in two or three days after the first appearance of the symptoms, and, as a rule, bad cases terminate during the second week. Others go on for six or seven weeks. The longer a patient lives the greater the hopes of a successful issue. Duration.

Prognosis.—In every case of blood poisoning great cause for anxiety exists, it being impossible to foretell its course or its end. In one case, a small dose of the poison will prove fatal, while in another a full dose will be thrown off. The violence of the attack does not depend upon the severity or size of the wound; for a trifling wound is at times followed by urgent symptoms, while a severe local injury may be followed by but few, if any, complications. Indeed, some of the severest cases of blood poisoning are found in those in whom there is no wound. Prognosis.

A robust person, doubtless, has a better chance of recovery than a feeble, and an abstemious one than a drunkard. Where diseased viscera exist, particularly diseased kidneys, the prospects of recovery are small indeed, the capabilities of a patient to resist any diseased action under these circumstances being slight in the extreme. A single attack of traumatic fever may pass off without trouble, but a relapse or a second attack always indicates serious mischief. Rigors rarely occur without suggesting the presence of some secondary deposit or local inflammation. One rigor may pass off and leave no trace of harm behind, but a succession of them is associated too frequently with the gravest local complications, such as secondary metastatic abscesses. These abscesses also when they occur outside any of the three great cavities of the body are less dangerous than when they occur in the viscera. Acute pyæmia is always accompanied with great danger; but when the disease is chronic there is always more hope.

The occurrence of pyæmia in different classes of cases is well shown in the following tables: Comparative frequency after injuries and diseases.

Analysis of the 217 *cases of Pyæmia.*

Of 217 cases—

68 or 31·3 per cent. were after compound fractures as a whole.
24 or 11· per cent. not amputated.
44 „ 20·2 „ amputated.
26 „ 12· „ were after amputation for disease.
28 „ 12·9 „ „ after other operations.
21 „ 9·6 „ „ after injury without operation.
60 „ 27·6 „ „ after disease without operation.
12 „ 5·5 „ „ idiopathic. 2·9 per cent. puerperal.

Through the kindness of Dr. Steele, who has aided me in this statistical investigation, I am able also to give the following interesting facts respecting pyæmia.

Out of 790 cases of compound fracture, 192 died, or 24· per cent.
68 of pyæmia, or 8·6 per cent.

Of 184 cases treated by amputation—
89 died, or 47·7 per cent.
44 of pyæmia, or 23·9 per cent.

Of 606 treated without amputation—
103 died, or 17· per cent.
24 of pyæmia, or 3·9 per cent.
Out of 324 cases of amputation of thigh, leg, arm, and forearm for disease . . . 126 died, or 38·8 per cent.
26 of pyæmia, or 8· per cent.

Pyæmia is thus seen to be three times as fatal after amputation for compound fracture as for disease.

Out of 29,434 surgical cases admitted into Guy's during 10 years, there were 1749 deaths, or 5·9 per cent.

203 of these were from pyæmia, or 11·6 per cent. of the fatal cases; about one in nine of the deaths arising from this cause.

But of the whole number of cases treated, pyæmia was fatal in one case out of about 150, not two-thirds per cent.

Pyæmia not a hospital disease.

But is pyæmia a hospital disease? Does it arise from causes that are generated in a hospital? or is it met with more frequently in a hospital because the class of cases in which it is most prone to occur are there treated? Is it found in private practice?

As an answer to the last question it is only necessary for me to refer to Mr. Prescott Hewett's presidential address at the Clinical Society in 1874, in which he gave the particulars of twenty-three examples of pyæmia occurring in private practice, and in six only after operations, four being very trivial operations.

Sixteen of these were in town and seven in the country, and all were placed under most favorable circumstances.

We know, moreover, that some of the worst cases of pyæmia that are seen in the London hospitals—and I can answer for Guy's—are admitted with the affection.

Under these circumstances it may confidently be asserted, that what is known as pyæmia is not peculiarly a hospital disease, and that it probably occurs after surgical injuries and operations as frequently in private as in hospital practice. It is true that pyæmia often takes its origin in hospitals, but equally true is it that it does so because the class of cases in which the affection is the most prone to occur are there to be found.

Blood poisoning may occur anywhere, in hospitals or in private houses; but it is unfair and unscientific to attribute it without reason or evidence to what has been so wrongly described as "Hospitalism."

Treatment.

TREATMENT.—An unlimited supply of fresh air, simple nutritious food, and, where a wound or suppuration exists, the most thorough *cleanliness*, are the main points of practice to be attended to in the treatment of every case of traumatic fever or pyæmia. Compared with these, all other means are of secondary importance.

As the disease is due to a blood poison, often taken into the body from without, it is the surgeon's duty to see that the patient's room is well ventilated, that it is neither too hot nor too cold, as both extremes are powerful depressants; that the air circulating through it is free, fresh, and fragrant; that the room is frequently purified by cleansing and disinfectants, large dishes of any disinfecting fluid and cloths saturated with the same being distributed about; solid iodine exposed in a plate to the air is a good disinfectant, and more persistent than some

others. Care must be taken that no poison from a drain or closet reaches the room; and that all excretions are disinfected at once, indeed, passed directly into vessels containing disinfecting fluid, such as Condy's, carbolic acid, chloride of lime, or chloralum. The wound should be kept *clean*, and care should be taken that all discharges are allowed a free escape. Dressings, when employed to a suppurating or sloughing wound, should be saturated with disinfecting lotions, and changed every three or four hours. When possible, foul wounds should be irrigated, a stream of warm water containing a disinfectant being allowed to run over the surface. I know of no means so valuable for keeping a wound clean as this. When sloughing of the part is present, charcoal poultices are at times beneficial. Sponges should never be employed where pus exists, but tow or cotton-wool, more particularly the absorbing cotton-wool known as Brun's; or camel's hair pencils kept in a lotion of carbolic acid, as suggested by Callender. Poultices, when employed, may be put on tow or oakum, both of which materials, through the tar they contain, being disinfectants. Disinfectants.

In simple, *uncomplicated traumatic fever*, when it stops within the ordinary bounds, and neither runs on nor returns in its severity, no special treatment is called for. Should restlessness or much pain exist, a sedative dose of chloral, opium or morphia, may be given, either by the mouth, rectum, or skin, and beyond this nothing is needed. *a.* In simple cases.

In more confirmed cases of suppurative fever, when systemic infection is declared, the vital energies of the patient must be maintained or stimulated, and everything that tends to lower must be warded off; thus the administration of tonic medicine becomes a necessity, the preparations of iron being the best, but strychnine and quinine are likewise of great use. Some surgeons employ very large doses of quinine, and speak highly of it,—from ten to twenty grains being given at the first onset of pyæmia, and repeated every three or four hours,—and Dr. Goodhart's investigations ('Guy's Hosp. Rep.,' 1870) seem to show that quinine in full doses helps defervescence. Stimulants must be administered with caution, and their amount regulated by the wants of the individual case. When the patient's habits have been free, alcohol in some of its forms will be required, even in large quantities; whereas to an abstemious person a very moderate dose will be sufficient, a large one doing harm; and that form of stimulant is apparently the best to which the patient has been accustomed. *b.* In systemic infection.

The diet should be as nutritious as possible, but its nature must depend upon the assimilative powers of the stomach. Where milk agrees, no better drink can be given, either alone or mixed with eggs or some spirit; cream may be added at times, or the concentrated Swiss milk; animal broths may likewise be freely used. When meat can be digested it may be given, although sparingly. When a patient refuses food, Liebig's extract of meat, or Darby's fluid meat, may be mixed with the beer or wine without his knowledge. When the stomach rejects nourishment it must be given by the rectum, an enema of beef tea and egg being administered every four or six hours. Ice may always be allowed in small quantities, as it gives comfort. Diet.

When the nervous system is disturbed from want of sleep or otherwise, opium may be given, small doses frequently repeated being better than large. Where enemata are used, laudanum may be mixed with them. Opiates.

Laxatives.

Should diarrhœa exist it must not be checked too suddenly, for in some cases of blood poisoning it appears to have an eliminative tendency; it should be stopped only when telling on the patient's powers. To give remedies, however, with the view of eliminating the poison by the bowel is a rash practice, and cannot be recommended. The sulphites and chlorides in any of their forms do not appear to have any power to neutralise the poison in the blood; they have been, however highly praised. The alkaline salts have likewise been strongly recommended "to promote the changing and eliminating of the products of the retrograde metamorphosis of the tissues" (Savory). Of these the carbonate of ammonia is probably the best, either given alone or with the liquid extract of bark.

Opening of pus depôts.

When secondary abscesses have formed in the cellular tissue and between the muscles they should be opened; but great caution must be observed in dealing with inflamed joints. When the presence of pus can be clearly made out it should be evacuated by a free incision into the joint, and care taken that it does not re-accumulate; when possible a drainage tube should be introduced into the cavity, and the joint daily freely washed out with a stream of warm water coloured with Condy's, or some other disinfecting fluid, such as carbolic acid, one part in forty, or iodine water composed of one drachm of the tincture of iodine to a pint of water. Soothing applications should at the same time be employed, poppy fomentations being probably the best.

When acute blood poisoning has set in, it is almost needless to say that amputation of a diseased limb has no influence in checking the disease, nor has the application of caustics or canteries to a wound; indeed, no local treatment is known by which the formation of secondary abscesses can be prevented. In chronic pyæmia, however, amputation is often of essential service.

How far blood poisoning can be prevented is another question, and as it is an important one it may be considered here.

Exciting causes.

As to the exciting cause of the disease nothing is known. It attacks the healthy as well as the cachectic; those surrounded by perfect hygienic influences, as well as those subjected to the most unfavorable, and it is found in private as well as in public practice. It is true that the cachectic, and those who are subjected to close and unhealthy atmospheres, are the more prone to its attack, and that overcrowding in small wards, bad ventilation, bad drainage, and bad feeding, with every other influence that has a depressing action on the vital powers, are known to have an injurious tendency. It becomes the surgeon's duty, therefore, to ward off, as far as he can, all such influences. In cases for operation, when time is allowed for preparation, the general condition of the patient should be investigated; care should be taken that the excretory glands are performing their functions, and, if not, they should, if possible, be at once corrected. The feeble must be strengthened by tonics and good nutritious food, and the supply of stimulants should be regulated in all. The intemperate man should be brought to see the necessity for moderation, and to know that life cannot long be sustained by drink alone; he must learn also that stimulants are chiefly of value in assisting digestion and the assimilation of nutritious food. The urine under all circumstances should be examined for albumen; for although its presence would not deter the surgeon from performing an

Prophylactics.

Value of stimulants.

operation of necessity, to save life, it would affect his prognosis, and would most certainly influence his decision in an operation of expedieney. All patients after operation should be kept in absolute repose, the wounds kept clean, and lightly dressed. Everything that tends to procure rapid union must be considered good, and all that induces or keeps up suppuration bad, blood poisoning and suppuration, whether with or without a wound, having a close connection. No one who has been in contact with any infectious disorder, such as erysipelas or scarlet fever, should be allowed to come near the patient; for there can be no doubt that there is some subtle connection between these poisons and pyæmia. And, lastly, every cheering influence should be brought to bear on the mind of the patient, as well as on his surroundings; for among the agents predisposing to blood poisoning, mental anxieties and depressing emotions should doubtless be reckoned.

Avoid infectious disorders.

HECTIC FEVER.

There can be little doubt that surgeons of former times included under the above heading many cases of what we now call septicæmia, pyæmia, or blood poisoning; and even at the present time it is an open point as to how far the symptoms which denote hectic fever are due to the absorption of some foreign element into the blood.

That hectic fever is never found except in those who are the victims of destructive organic changes, chiefly of a suppurative nature, is an established fact; and it is in such also that confirmed blood poisoning generally occurs. The physician meets with this condition in pneumonia, phthisis, empyema, abscess in the liver, kidneys, or ovary; the surgeon in suppurative diseases of joints and bones, in spinal disease, compound fractures, diffused suppurations, &c. In all classes of cases there is a destructive wasting and influence at work, undermining the patient's powers and producing general emaciation. The characteristic symptoms are of a remittent character, and usually appear at least once daily, generally towards evening, but they may occur more frequently. They are not unlike those of ague.

Symptoms.

A paroxysm of hectic may be said to commence with fever, of more or less intensity; the skin will be hot and dry, the pulse rapid and feeble. The face, too, will be flushed in a single patch, and the palms of the hands and the soles of the feet hot and burning. The tongue during the paroxysm may be dry, and great thirst present. There will, however, be no brain symptoms, no clouding of the intellect, no delirium. The febrile condition may be preceded by shivering or chilliness, but such symptoms are unusual, and are always followed by *a profuse and exhaustive sweat*. This sweating is indeed peculiar to the affection, for it bears no proportion to the febrile symptoms that preceded it. At the commencement of the disease the febrility may be so slight as hardly to be noticed, and yet the patient on falling to sleep and awakening will be bathed in perspiration. When the disease is at its height the cold, hot, and sweating stages may be easily seen; but when it declines the febrile symptoms will be constant, although aggravated towards night, while the morning "colliquative" sweats gradually become more profuse as life ebbs away.

Fever.

Rigors.

Sweating.

In the early stage of this disease, *between* the paroxysms, there may be no fever. The tongue, dry during the attack, will be moist and clean, but, towards the close, becomes morbidly red, smooth, and sore, with aphthous ulceration. The appetite and digestive organs are rarely much affected; indeed, they are little altered till the general powers are failing rapidly. The skin, at first supple and moist between the attacks, becomes as the disease progresses harsh, dry, and covered with branny scales. The urine, always scanty and high coloured, is more so towards the close of the disease. The bowels are sometimes constipated, but more frequently loose. Throughout the disease, however, the mental faculties remain unimpaired, even when the bodily powers are reduced to a minimum. During the whole disease sleep is usually obtained between the attacks. Death always ensues from exhaustion, and bed-sores too frequently form, adding to the sufferings of the patient.

Treatment. TREATMENT.—The removal of the cause of the disease is the only means by which a cure can be effected. As the affection is one purely of exhaustion, the object must be to maintain the strength of the patient in every way by the administration of abundance of simple nutritious food, with stimulants carefully adjusted to the special wants of the case. The former should be given at certain short intervals in small quantities, and the latter in sufficient quantities to aid digestion.

Tonic medicine should always be given, quinine probably being the best, as this drug has, doubtless, a power in checking febrile action, in keeping down the temperature of the body, and in preventing sweats. It should be given in a full dose, five grains in the solid form, before the paroxysm. Iron and strychnine are also valuable drugs, and the extract of belladonna in doses of half a grain or more combined with the tonic is of great value. Diarrhœa, when present, should be checked by astringents, but opium should be sparingly employed, except to relieve pain.

Question of operation. With respect to the removal of the cause of the disease by operation when such is possible, there can be no difference of opinion among surgeons; for hectic is a proof that nature's reparative powers have been found wanting in their efforts to cure the local affection, and under these circumstances the surgeon's duty doubtless lies in operative interference. If the disease can be removed, this should be done, and delay is almost criminal. Let the source of irritation, or weakness, be removed, and it is wonderful how rapidly the most feeble subject may rally after the operation. If the viscera are sound, good hopes of a recovery may be entertained under apparently the most adverse conditions; but if the kidneys are diseased, the prospects of recovery are feeble.

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CHAPTER II.

ON ANIMAL POISONS.

POISONED WOUNDS.

On poisoned wounds.

UNDER this heading, Dissection wounds, wounds from the sting or bite of healthy insects and animals, and wounds from the bite of diseased animals, or inoculation from their blood, will be considered.

Dissection Wounds.—These are of frequent occurrence, although it is exceptional to find them followed by any seriously ill effects. In common with all wounds, they may be attended with absorbent inflammation, inflammation of the cellular tissue, suppuration, septicæmia, or pyæmia; and feeble or cachectic subjects are more liable to any one of these consequences than the strong and steady.

In exceptional instances, however, different results follow, and two forms of the affection may be recognised—the *mild* and the *acute*.

Symptoms of mild form.

"The symptoms in the *mild* form partake," says Polaud, "more or less of the ordinary character of non-specific inflammation, and scarcely present any noticeable characteristic signs; thus, the local appearances consist in the puncture assuming a defined red aspect, which soon becomes pustular; this bursts, and ends in an unhealthy suppuration; there is surrounding erythema of an erratic form, and inflammation and pain extending along the forearm and arm to the axilla, ending in the enlargement and suppuration of the glands. The constitutional effects consist in febrile disturbance, loss of appetite, diarrhœa, fetid eructations, &c. The prognosis and termination are favorable; and the treatment required is to be based upon general principles. The symptoms of the *acute* or severe forms are those of a truly specific disease; the local signs commence by the appearance of a small circular or oval vesicle over the seat of puncture, which soon becomes turbid, milky, and pustular, and not unfrequently has a defined margin, resembling somewhat that of smallpox. This is generally unattended with pain; but the patient often complains of intense pain in the shoulder and about the axilla, which shoots down the chest. The glands in the axilla are early affected, and seem to act as barriers to the further progress of the poison; they become enlarged, and the surrounding cellular tissue is implicated, with serous effusion; there is erythema and puffy swelling; these extend to the subscapular and pectoral regions, spreading down the side of the chest, yielding to pressure, and imparting a peculiar spongy feel. There is, besides, an œdematous and doughy condition of the arm and forearm, owing to serous exudation into the cellular tissue, which seldom, if ever, passes into suppuration."

Symptoms of severe or acute form.

Constitutional symptoms.

"The constitutional symptoms are at first those of strong excitement; but these are soon followed by those of extreme depression of spirits and much suffering. Rigors, headache, prostration of strength, vomiting, &c., supervene; and, lastly, all the symptoms of low typhoid fever rapidly set in."

In some cases the absorbent glands are not involved, and death may occur from prostration in the early stage of the disease; in others, suppuration and pyæmia may appear, while in a third extensive

and diffused sloughing of the skin may ensue—all these points being materially influenced by the power of the patient to throw off morbific influences.

Prognosis of acute form.

The *prognosis* in these acute cases must be unfavorable. Travers calculated that one in seven recovers; probably this is rather in excess of experience; but if the patient does not sink during the violence of the attack, his powers will be tried to the utmost by the protracted suppuration.

The inoculation from a recently dead body is more serious than that from an old subject of the dissecting-room, and the fluids from a patient who has died from glanders, peritonitis, and scarlet or puerperal fever, are far more dangerous than all others. There is reason, indeed, to believe that the contact with such fluids is capable of giving rise to the disease without any local wound or abrasion.

Treatment of poisoned wounds.

TREATMENT.—To keep the patient alive and to treat on general principles any local symptoms as they arise is the usual method now pursued.

A student when he pricks his finger should at once clean and suck the wound, and at the same time arrest the circulation of blood through it for at least a minute, by pressure applied with the opposite hand on its cardiac side. The part may then be closed over, a piece of gutta-percha skin made adherent with chloroform being an admirable application. When the wound is free and the poison is from a recent puerperal or allied case, some caustic such as the nitrate of silver, chloride of zinc, or even nitric acid may be applied. The first two are probably the best. When any inflammation appears, a poultice should be applied, and the hand raised above the shoulder, and, if there should be any tension of the part, it is to be at once relieved by an incision.

Absorbent or cellular inflammation should be treated by fomentations. Some surgeons have faith in the local application of nitrate of silver, iodine, or the solution of the perchloride of iron as a means for arresting its progress. The glands when enlarged should be freely bathed with hot water, and hot fomentations constantly applied. The earliest indications of suppuration ought to be looked for in order that pus may be at once evacuated. Sloughs are to be removed by moderate incisions. Tonics should be given from the first, iron when it can be borne with or without quinine in full doses, or ammonia and bark when the former tonics are inapplicable. Nutritious food ought to be given in abundance, milk being the best drink; stimulants, too, when needed, but always with caution. Country air, as soon as it can be enjoyed, is the great aid upon which reliance may be placed for recovery.

Anatomical or Pathological Tubercle.

Anatomical tubercle.

This is a chronic skin affection, which is to be met with on the hands of those constantly engaged in making post-mortem examinations. Dr. Wilks, when describing some models of the affection that are to be seen in Guy's museum (Fig. 11), called it "*verruca necrogenica*" ('Guy's Rep.,' 1862). In its early stage it is not unlike epithelial cancer. "It commences without any evident breach of surface, the parts affected being not those liable to pustules, as the back of the hand or wrist, but the knuckles and joints of the fingers. If the disease should begin with a pustule, the pustule bursts, but instead of healing, a

thickening of the cuticle takes place around it, and as from time to time a little fresh suppuration occurs, so the thickeniug and indnratiou increase. Generally, however, these changes go on slowly, without any preliminary vesication. A warty thickening of the epithelium takes place, which, in course of time, becomes of a dark colour, until a kind of ichthyotic condition is produced."

Fig. 11.



Anatomical tubercle.
Model Guy's Mus. 1935[0].

The disease is local, and unattended by constitutional symptoms. The repeated application of the strong tincture of iodine, acid nitrate of mercury, or nitric acid, will effect a cure.

Insect stings.

Insect stings in this country are not very severe, and, unless inflicted in large numbers, are rarely brought under the notice of the Surgeon. Slight fever and constitutional disturbance may follow them in some children who are susceptible to external influences, whilst local swelling, heat, and redness are very marked in others. Should a wasp or bee accidentally be taken into the mouth with fruit, and the base of the tongue, pharynx, or larynx stung, serious symptoms may appear by the œdema and swelling of the parts impeding respiration. When this accident happens, scarifications should be employed with fomentations, but if life be threatened, the windpipe must be opened.

When the tongue or other accessible part is affected, the sting should be removed, if possible, with a pair of fine forceps, and thus much pain is saved. Where this cannot be done, a drop of either the liquor ammoniæ, sal volatile, or oil of lavender, applied to the part generally gives relief. The parts should also be protected from the air by collodion, flour, chalk, or strapping.

The bite of the scorpion, the tarantula, and other tropical insects is, however, more troublesome, and is often followed by nervous depression, vomiting, and local pain. In South America, the mosquito bite is at times attended with severe local inflammation, and sometimes with ulceration. In Africa and Asia, the scorpion, which is from six to ten inches long, is so venomous as to cause, by its bite, at times, loss of life. Olive oil is the usual application for the wound, but liquor ammoniæ is probably better. Brandy and ammonia should be given internally when great depression exists.

The bite of the spider is very similar in its effects to that of the scorpion, though the wonderful stories as to its poisonous qualities are now regarded as fabulous.

Serpent bites.

Serpent bites are often serious, and at times fatal, the poison being squeezed into the tissue in the act of biting, from a special apparatus situated at the base of the upper fangs. In England, the *viper* is the only poisonous reptile, and although some local and constitutional disturbance may follow its bite, a fatal result rarely ensues.

The *cobra di capello, rattlesnake, whipcord snake*, and *phoorsa snake* are the most venomous.

In some cases the poison seems to spend its effects upon the nervous system, killing by convulsions or coma; in others, its local effects are the more important,

Mitchell's account of rattlesnake bites.

Dr. S. Weir Mitchell, of Philadelphia, who has carefully studied the effects of poison by the rattlesnake, states that the bite is sometimes followed by pain of a pricking or burning character, which gradually becomes more intense, also by bleeding, swelling, and discoloration of the injured part and tissues around, these symptoms depending upon the effusion of blood into the cellular tissue. The wounded extremity becomes larger and the pain greater, the skin assuming a mottled marbly aspect. As secondary effects, inflammation and disorganisation of the tissues occur; the inflammation assumes more the character of the phlegmonous erysipelas, and is associated with glandular enlargement and suppuration, followed by gangrene as a common consequence.

Great depression of the nervous system and general prostration are the most prominent constitutional symptoms, with profuse cold sweats, vomiting, dyspnœa, and diarrhœa; and jaundice often precedes death.

Prognosis.

When the dose of the poison is large, or the susceptibilities of the patient acute, death may take place at once from general prostration and local stagnation of blood in the wounded extremity. In the case of a keeper of the London Zoological Gardens, who was bitten in the nose by a cobra death took place in little more than an hour after the infliction of the wound, and half an hour only had elapsed when he was apparently dying, being unable to speak, swallow, or support himself; the pupils became dilated, the face livid, the heart's action feeble, and he was scarcely conscious.

Mitchell has recorded a case which proved fatal in five and a half hours. Of others one died comatose, another with dyspnœa and dysphagia, a third felt sleepy and died without agony.

On the other hand, patients at times recover suddenly, even when the symptoms have been severe, as if the poison had suddenly lost its power. More commonly, however, death ensues, and when recovery follows, it is only after severe local suppuration and sloughing, leaving a maimed and useless limb.

Appearances after death.

After death Mitchell found ecchymoses in the thoracic and abdominal viscera, the spots containing blood-cells, this exudation being purpuric in its nature, and clearly caused by a want of the normal coagulating power in the blood; this altered condition of the blood indeed is the most common effect of snake poisons, and in some cases it is said to last through life. Hence, in bites from the Indian phoorsa snake, there is said to be a hæmorrhagic tendency during life. After death Mitchell could never detect the least alteration in the blood-cells in acute cases, but in exceptional examples of chronic poisoning he found a few globules indented. In chronic cases also, where there has been time for the poison to act upon the blood, the want of coagulating power in the blood is very constant, and putrefactive changes rapidly follow.

Dr. Halford, of Melbourne, says he always found the blood after death dark and fluid. It also contained germinal nucleated cells,

which he regards as molecnles of living foreign matter thrown into the blood from the venom, and he accounts for the asphyxia and death by the increase and multiplication of these molecules, which takes place at the expense of the oxygen normally wanted in inspiration.

Sir J. Fayrer tells us, however, that he has never been able to detect these changes in the blood, although the poison affects the blood primarily, and the nervous centres indirectly through it. ('Indian Annals of Med. Science,' 1870.)

Treatment of serpent poisoning.

Treatment should be most energetic, otherwise the depressing influence of the poison will soon paralyse all action, a few seconds often being enough for the absorption of the poison.

Local.

Locally, the aim should be to arrest the absorption of the poison by fastening a ligature firmly on the cardiac side of the wound, by excising the wounded part, and by the application of nitric acid, carbolic acid, or the nitrate of silver.

Fayrer records, that the natives of India apply a ligature not only just above the bite, but at several places on the limb at intervals of some inches; they then place a red-hot coal upon the wounded part. The danger and difficulty lie in not applying the ligature quickly enough. The ligature must also be tightened to the utmost, till the circulation is entirely arrested and the part is livid with retained blood. The punctures should then be scarified to allow the blood to flow freely, and the cautery or caustics afterwards be applied.

Constitutional.

Constitutionally, the best treatment lies in the administration of ammonia and stimulants in sufficient quantities to maintain the action of the nervous and circulatory systems, and thus to keep the patient alive whilst the poison is being worked off or becomes exhausted; for the man who is dying from snake bite is perishing from rapid exhaustion of nerve force. Any other measure that can rouse and stimulate the failing nervous energy may also be employed.

Fowler's solution in full doses every half hour for four hours is said to have been useful. Iodine has also been advocated, and olive oil internally in full doses has been highly praised. In countries where poisonous snakes abound, different roots have their reputation, such as the guaco, the sacræ vitæ ancora, radix corneæ, decoction of Virginia snake-root, &c. &c.; but Fayrer, after repeated experiments, believes them to be utterly useless.

Injections into veins.

Halford has inferred from his experiments that the injection of twenty to thirty drops of a solution of one part of strong liquor ammoniæ to three parts by measure of water into one of the veins of the wounded limb, accompanied by the local application of liquor ammoniæ to the part, is a specific; but Fayrer, who has tried the practice, has failed to find the success looked for.

Ligature on cardiac side.

Mitchell advises ligature on the cardiac side of the wound; or excision, amputation, or destruction by cautery or escharotics of the poisoned part; and even *suction* of the wound immediately after the bite, as the poison has no influence in the stomach. He thinks well also of the injection into the wound of iodine or ammonia, and says the natives believe the local application of olive oil to be the best. Together with this local treatment, the patient is to be kept up by hope, the action of the heart sustained by stimulants quite irrespective of quantity, and the general powers maintained by nutritious food. By these means, "if the person be not thoroughly

poisoned, we may help him to recover. If he be badly bitten by one of the more deadly snakes, we can do no more." (Fayrer.)

Bites of Diseased Animals.

Hydrophobia. **Hydrophobia**, meaning the "dread of water;" which is more correctly termed "RABIES," is a disease contracted from a rabid animal, generally from its bite through its saliva or mucus. It appears at all seasons of the year, and is always fatal.

It is more common in temperate regions of the world than in the torrid and frigid zones. It is unknown in Australia, New Zealand, Greenland, and Kamschatka.

Blaine and Youatt affirm that in animals, rabies is entirely due to a traumatic action, viz., the bite of some rabid creature inflicted on another previously free from the disease. Fleming, the most recent authority, tells us, however, that the virus of rabies may, under certain favorable conditions, be generated directly without the intervention of any infecting medium, although at present we are in complete ignorance of the conditions on which its spontaneous production depends. All animals bitten do not contract the disease, as is proved by Renault of Alfort, who caused dogs, horses, &c., to be bitten several times, and even inoculated them, when out of 99 cases, 67 contracted the malady, and 32, or one third, escaped. Fleming calculates that 30 or 40 per cent. of people who are bitten by mad animals go mad.

Symptoms in the dog. In the *dog* there are three well-marked stages of the complaint. The *first* is the *melancholic*, characterised by melancholy, depression, sullenness, and fidgettiness; the *second*, the *furious*, by excitement, or rabid fury; and the *last*, the *paralytic*, by general muscular debility and actual *paralysis*.

Stage of depression. "The dog," writes Tronsseau, "looks ill and sullen after a period of incubation of very variable length; he is constantly agitated, turning round and round inside his kennel, or roaming about if he is at large. His eyes, when turned on his master, have a strange look in them, expressive of sadness as well as of distrust. His attitude is suspicious, and indicates that he is not well; by his wandering 'he seems to be seeking' for a remedy. He is not to be trusted; if he obeys at all, he does it slowly; if you chastise him he may, in spite of himself, inflict a fatal bite."

Stage of excitement. "His agitation increases; if in a room, he runs about looking under the furniture, tearing the curtains and carpets, sometimes flying at the walls, at others jumping as if to catch flies; the next moment he stops, stretches his neck, and seems to listen to a distant noise. He probably has then hallucinations of sight and hearing."

"This delirium," says Youatt, "may still be dispersed by the magical influence of his master's voice; all these dreadful objects may vanish, and the creature creeps to his master with the expression of attachment peculiar to him."

Stage of muscular debility. "There follows then an interval of calm; he slowly closes his eyes, hangs down his head, his fore legs seem to give way beneath him, and he looks on the point of dropping. Suddenly, however, he gets up again; fresh phantoms rise before him; he looks around him with a savage expression, and rushes against an enemy which only exists in his imagination. By this time the animal's bark is hoarse and muffled; loud at first, it gradually fails in force and intensity, and becomes weaker and weaker. In some cases the power of barking is completely

lost; the dog is dumb, and his tongue hangs out through his half-opened jaws, from which dribbles a frothy saliva. Sometimes his mouth is perfectly dry, and he cannot swallow, although in the majority of cases he can still eat and drink. When he cannot drink, he will lap fluids with great rapidity, but on looking closely it will be seen that he merely bites the water. He can still, in some cases, swallow solids, and he may then swallow anything that is within his reach, bits of wood, pieces of earth, straw, &c." Still laps fluid.

"Towards the close of the second stage of rabid fury the dog often breaks his chain and runs away; he wanders about the fields, being seized from time to time with paroxysms of fury, and then he stops, from fatigue, as it were, and remains hours in a somnolent state. He generally dies in a ditch or retired corner, apparently from hunger, thirst, and fatigue."

Veterinary surgeons do not say that he dies from asphyxia, brought on by spasm of the pectoral muscles or by convulsions. The disease runs its course in from five to eight days, and it is the same in the dog, cat, horse, and wolf, from any of which man may become inoculated.

In man the disease may show itself at any period from six weeks to a year after the inoculation, although Fleming and Bouley assert that the incubatory period in man varies from one to two months, and that after the third month the chances of immunity are great. Thamhayn ('Schmidt's Jahrbuch.,' 1859), in an analysis of 220 cases showed, that in 49 the symptoms appeared within a month, in 98 during the second, in 29 during the third, and in 26 during the fourth month; 16 of the remaining cases showing themselves within twenty-six months; two cases only maturing at a period of four and five and a half years respectively. But these cases are always doubtful, and are probably examples of hysterical or *nervous hydrophobia*. Fleming, however, records some striking cases which seem to show, that the latent disease may be induced or brought into activity by mental agitation ('Rabies and Hydrophobia,' 1872). Symptoms in man. Period of incubation.

The disease may attack the infant at the breast or the aged, the male or the female, and during the incubative stage no disturbance of the general health can be observed. Van Swieten has pointed out that during this period such a disease as variola may run its course without any modification, two poisons thus coexisting in the same frame.

After the incubative stage has passed, the *first symptom* usually displayed is that of sadness; the victim either not suspecting his complaint, or carefully avoiding mentioning the circumstance. His sleep is disturbed; he is fidgetty, sighs deeply, and avoids society; he is troubled by noise; or is very irritable and ill-tempered. The *second stage* will be marked by an aggravation of all these symptoms, but there will be in addition pain in the region of the heart with some irregularity of the pulse. Rigors will soon appear, which, says Trousseau, "are true convulsions of all the muscles of the body;" and lastly, the characteristic symptom of dread of water, not as fluid, however, but as connected with the difficulty of drinking. The sight of water is frequently sufficient to bring on shuddering, yet it is when the patient carries water to his lips that he is seized with the typical terrors. A rabid man is always rational and tries to drink, but the attempt excites terror, and the expression of his inability. His eyes Premonitory symptoms. Second stage. Characteristic symptoms.

become fixed, features contracted, and his countenance expressive of the deepest anxiety, his limbs shake and the whole body shivers. The paroxysm lasts a few seconds, then subsides, but only to be renewed on the slighest breath of air touching his body, for *hyperæsthesia* is one of the most marked symptoms of the affection.

During the calm, nausea or even vomiting may appear, and priapism is often a most distressing symptom. Sudden terror of an unknown kind haunts the mind, and imaginary calling of fiends often exists. Dr. Bergerons records a case in which the patient heard the ringing of bells, and saw mice run about over his bed.

Final symptoms.

In the third and last stage the longing for drink becomes intense, with an increasing inability to take it; the voice becomes hoarse and the mouth full of a frothy fluid. The patient tries to get rid of this by spitting, and then becomes frightened at its results. In some cases he fears that by contact this fluid may propagate the disease. Convulsive seizures increase in frequency and intensity, the spasm of the respiratory muscles threatening life; at last a fatal spasm takes place, and death by asphyxia ensues.

Cause of death.

In the dog, death results from paralysis, in man, generally, from asphyxia; in exceptional cases it is due to exhaustion.

Duration of the disease.

This painful affection rarely lasts longer than four days, though it has been fatal in sixteen hours, and has lasted as long as two or three weeks. Thanhayn shows that 56 out of 202 cases died within forty-two hours, 73 in forty-eight hours, 38 between the second and third days, 19 between the third and fourth days, 7 in five, 5 in six, and 4 in seven days.

Condition of wound.

The seat of wound or cicatrix rarely shows anything unusual. In three or four cases out of a hundred it may be slightly painful, irritable, or inflamed, or the seat of a neuralgic pain, the pain being a kind of "aura," as in epilepsy; in some instances it is very severe.

Diagnosis.

Diagnosis.—Taken as a whole, there is no disease like hydrophobia. In a certain sense it resembles tetanus, yet the two, in their general features, are unlike. They may, however, occur together, and so good an observer as Dr. J. W. Ogle has published a case of combined tetanus and hydrophobia in the 'British and Foreign Medico-Chir. Review,' 1868.

What Trousseau has called nervous hydrophobia, true dysphagia, brought on by a dread of rabies, may, however, be mistaken for it; "but the sudden invasion of this complaint, generally coming on through the person recalling to mind or hearing the relation of a case of true hydrophobia, and the duration of the dysphagia over the period of four days are amply sufficient to characterise the complaint, and to enable the practitioner to persuade the patient that he is suffering from mere nervous symptoms, which will vanish as soon as he ceases to fear. Besides, in nervous hydrophobia there is dysphagia only, but no general convulsions, the spasm affecting the pharynx alone, while the breathing goes on with regularity."

Marochetti's views.

In the very early period of the disease, during its incubation, Drs. Marochetti, Magistel, Xanthos, and others, have called attention to the presence of pustules or vesicles near the frænum of the tongue, known in Greece as *lyssi*, and they assert, that if these *lyssi* are cauterised, all manifestations of disease can be prevented. Should these observations be confirmed a valuable means of diagnosis as well as of treatment

in the very earliest stage of the disease will have been found. These lyssi are said to show themselves at an earlier period in proportion to the amount of poison deposited in the wound. Marochetti made early incisions through the vesicles, and then cauterised the surface with a red-hot iron, with, he states, invariable success.

Pathology. Pathology.—There are no pathological lesions peculiar to hydrophobia—at least, none such have as yet been described. Mr. Durham, in a case that occurred at Guy's in 1865, carefully examined the cord, prepared after Dr. L. Clarke's method, and found extreme congestion of the grey matter of the cord, and numerous minute patches of extravasated blood in different sections. More recently Dr. Benedikt, of Vienna, has made out that in dogs "the pathological process in this disease consists in acute exudative inflammation, with hyaloid degeneration, which doubtless arises from the exudative infiltration of the connective tissue of the brain." ('Wiener Mediz. Presse,' June, 1874; 'Lond. Med. Rec.,' Sept. 30, 1874.)

Treatment. Treatment.—In all cases of bites from dogs or animals in which the faintest suspicion of rabies exists, free cauterisation with lunar caustic should be performed. Youatt states that he adopted this practice in upwards of 400 cases, and four times on himself, with complete success, and that in all these there was no doubt as to the dog being mad. With such a result no other caustic need be used; when this is not at hand, any acid, caustic alkali, or cautery, will suffice. When the escharotic cannot be obtained the part may be excised, a ligature being fastened beforehand on the cardiac side of the wound. Some surgeons advise amputation.

Mental stimulants, in the way of inspiring hope and removing fear, must be freely administered, and such general treatment as may be needed. No drug has yet been found that has the least influence on the disease, either in preventing or curing it. Dr. Marochetti's treatment of the lyssi is the only one that can claim any degree of success. How far the constant administration of chloroform would influence the disease is a question that has yet to be put to the proof. To prevent asphyxia from taking place, tracheotomy, as suggested by Dr. Marshall Hall, is a justifiable measure, the operation being based on a good theory, although it has never been performed on the human subject. By it the immediate risk of death from asphyxia would be rendered impossible, and time given for remedies to act or for the disease to run its course. It seems that six or seven days is the utmost period for the disease to be in existence. If life can be prolonged thus far, the hope of a good result may be entertained. Anything that can tend to prevent death, and keep the patient alive, is useful. Tracheotomy is one of these means, and deserves trial, wine and food being valuable adjuvants.

When a dog is known to be mad, it ought to be destroyed; but when any one has been bitten by an animal in which there is no evidence of madness, it should be kept, although apart from others, and guarded, as time will prove the truth of his condition, and do away with the morbid fear of "rabies" that may have been excited by the injury.

Glanders.

Glanders. This is a specific disease given to man by inoculation from the horse.

Varieties. Dr. Elliotson first recognised its true nature, and described it under the term Equinia. It shows itself in two forms. In one the disease attacks the mucous membrane of the nose and the neighbouring glands, and is then termed "*glanders*." In the other it affects the lymphatics of the body generally, giving rise to tumours or a knotty condition of the subcutaneous glands, called "*farcy buds*," and is therefore called "*farcy*."

In man, these two forms are generally found together.

Symptoms. There is said to be a stage of incubation varying from two to fifteen days from the inoculation, after which febrile symptoms with excitement appear, followed by the specific eruption. The pains in the limbs accompanying the febrile condition are generally associated with tenderness wherever glands exist, and, on examination, some enlargement of these glands will be found.

Characteristic eruption. The eruption is very characteristic, being made up of a crop of vesicles, which become pustular, and are very hard, resembling those of variola more than anything else. They are arranged in groups, with inflamed bases, the face, neck, and abdomen being, as a rule, more covered than the extremities; when close together, they become confluent. These pustules, with their indurated bases, then soften down, leaving ulcerated excavated surfaces. They affect the mucous lining of the nose, giving rise to the discharge.

Virchow's view of the pustules. Virchow says that "these so-called pustules are really due to the presence of a tenacious deposit in the corium of the skin, which has much resemblance to tubercle, and microscopically is made up of an amorphous granular appearance mixed with cell-elements, cell-growths, and fat-globules." ('Handbuch.') This opinion is supported by the clinical fact that tubercles in farcy are so often found in the subcutaneous tissue, appearing as hard circumscribed blind boils, or swellings, more or less diffused. These soften down, giving rise to extensive sloughing of the skin and surrounding parts, and are rarely absorbed. During the progress of the disease, soft tumours, not unlike pyæmic cutaneous abscesses, appear about the body, sometimes attacking deeper parts. In the more advanced stages of the disease, these tubercles or so-called pustules attack the larynx and whole respiratory tract, and more particularly the lungs, giving rise to Virchow's pneumonia of glanders, an affection consisting of a series of tubercles beneath the pleura coveriug the lungs, surrounded by lobular pneumonic inflammation, as in pyæmia. These tubercles are said to have been found in the testicles, kidneys, pancreas, and joints.

When attacking the nose. When they attack the nose, which they usually do at an early period, often before they appear in other parts, the secretion from the nose is at first catarrhal, thin, and clear, subsequently thick, tenacious, and puriform, often mixed with blood, but in many cases it is altogether absent or not noticed till a later period of the disease. The face and head often swell from œdema, presenting a puffy, erysipelatous, shining surface; the conjunctiva also secretes a thick secretion, glueing the eyelids. The tonsils are frequently involved, and often suppurate. As the disease progresses the swellings and discharge increase, the inflammation around spreads and becomes gangrenous, bullæ appear on the skin, the constitutional symptoms become typhoid, a low delirium sets in, not unlike that from pyæmia, and

death ensues from coma and exhaustion. When the glands and absorbents are involved, as in the farcy form, suppuration and sloughing, are superadded to those already laid down. Constitutional symptoms.

The *prognosis* of glanders is most unfavorable, recovery only taking place in the mildest cases of poisoning. The disease in its acutest stage may prove fatal in a week; indeed, it has run its course in three days, but in general it lasts for three or four weeks, and in very chronic cases life has been prolonged for months. In chronic "farcy," where sloughing glands have left large sores, these may remain open for a long time; occasionally such chronic cases end by an attack of acute disease. Prognosis.

The post-mortem appearances have been well described in two recent cases, in both of which there was the absence of nasal discharge. One was Dickinson's case, and the other Poland's, from whose paper, in 'Holmes' Surg.,' vol. i, I quote. The first-mentioned subject died on the twenty-first day. The blood was found fluid, the muscles soft and rotten, the cervical and left parotid glands suppurating, the lower part of the right lung solid with grey hepatisation, its tissues completely broken down and infiltrated with purulent fluid, and the left lung studded with numerous slate-coloured patches of the size of hazel nuts. Post-mortem appearances.

The second patient died on the thirteenth day. There was no affection of the lymphatic glands, but suppuration had taken place in the muscles of both calves of the legs, accompanied by local abscesses in other parts of the body, chiefly in the muscles; the joints were free from suppuration; there were recent patches of lymph on the pleura, and lobular pneumonia in the base of the upper lobe of the right lung, which was in a state of grey hepatisation; the lower lobes of both lungs throughout contained smaller hepatised masses; and the liver was free from disease.

Billroth lays great stress on the presence of hæmorrhagic abscesses in the muscles as being characteristic of the pyæmia of glanders. Abscess in muscles.

In man, the poison is generally communicated through the nasal discharge from the horse and the discharge from farcy swellings. Where the inoculation takes place from the latter the disease in man is more of the character of farcy. It can be communicated from man to man. The poison, to be absorbed, requires, as a rule, a wound or delicate membrane, yet cases are on record where the disease has been set up by wiping of the face with unclean hands or cloths. Mode of inoculation.

Youatt states that the disease is not one tenth part so common as it was, and "generally speaking, it is only found as a frequent and prevalent disease where neglect and filth and want of ventilation exist." Youatt's remarks.

Glanders, writes Dr. G. Milroy ('Trans. Epidem. Soc.,' vol. i), is "a *general* as well as a *propagable* disease; it is extremely apt in some seasons to develop itself in foul, unventilated stables." Its development may, however, be controlled even to absolute prevention by the observance of simple sanitary rules.

Treatment.—To keep the machinery of life going, and to treat symptoms upon ordinary surgical principles, seems to be the best mode of practice, for there is no drug which has any influence on the disease. Abundance of fresh air should be provided, with good but not too stimulating food, accompanied by tonics, such as quinine and iron; pain should be soothed by sedatives. When the nose is a source of trouble, it should Treatment.

be kept clean by washing, a stream of water passed through the nostril, followed by some antiseptic lotion, such as that of iodine, carbolic acid, Condy's fluid, or creosote; nitrate of silver solution, tannic acid, and others more stimulating, being at times valuable. Where the throat is affected, it should be sponged with some nitro-muriatic acid lotion, and a gargle of chlorate of potash used.

Early opening of abscesses.

Abscesses and softened tubercles should be opened early and freely, poultices and fomentations being applied to the parts. When they are very numerous, this practice is, however, difficult to follow. Perfect cleanliness should, of course, be observed.

Glanders in the horse.

Glanders in the horse, as Mr. Youatt tells us, in his book on that animal, is chiefly to be recognised by the persistent *discharge* from the nostril and the singular *hardness* of the submaxillary glands, which become adherent to the bone, from the effusion of inflammatory lymph around them. These glands are not very large except at the commencement of the disease, neither are they hot nor tender.

When any doubt exists as to the nature of the disease, a condemned horse or ass would be inoculated with the nasal secretion of the suspected animal, and if the disease be genuine it will be reproduced in a few days.

Equinia mitis.

Equinia mitis is a local pustular disease affecting the hands and body of those who dress the heels of horses affected with what Jenner has described as the "*grease*"—an inflammation and swelling of the heels of the horse, attended with the secretion of a thin acrid matter. It is not unlike ecthyma or vaccinia, but more angry; the pustules are about the size of a sixpence; they suppurate on the third day, dry up about the tenth or twelfth, forming scabs, which leave cicatrices. The disease runs its course, and is to be managed by rest and cleanliness.

SYPHILIS.

Definition.

SYPHILIS is a constitutional disease, the result of a specific animal poison introduced from without. Like other specific animal poisons, it is, as a rule, propagated by some local inoculation; but, unlike all others, it has, by its subtle influence through the parents, the power of affecting the unborn fœtus and the newly born child. No other blood poison appears to possess this power, at any rate to the same degree, and it is well to bear this important point of difference in mind, for, in all other respects there is a strong analogy between all.

Mode of its introduction.

Characters.

The poison once introduced into the system, either by inheritance—*inherited syphilis*—or by some local inoculation—*acquired syphilis*—manifests its presence in its own peculiar way, by the appearance of a somewhat irregular although characteristic chain of symptoms. These are uncertain in the period of their manifestation after the inoculation, in the order of their appearance, and in their form and effects, yet they possess their own special features. They are local and general. They run their course, yet do not eliminate the poison. They may disappear for a time to reappear in some other form. The poison may lie dormant for years, and in healthy subjects show no signs of its presence till some weakening influence has depressed the powers of its victim, and given rise to a local affection in which the practised eye will read with more or less certainty the modifying influence of an antecedent syphilitic affection. The poison has been

scotched for a time only, but not killed, and in the weakness of its possessor has reasserted its power.

No other animal poison appears to have such tenacity of existence. All others produce their specific effects in a definite way and in a regular series of symptoms, and are either eliminated or destroy life; having made their mark and run their course, they cease to act and are innocuous; their power for harm being exhausted. The poison of syphilis, however, is so subtle that it is tolerably certain most of the secretions of a syphilitic subject are capable of producing the same disease in another; clinical experience having disproved Hunter's opinion that syphilis could only be propagated by the secretion of a primary sore, and Ricord's proposition, that "a chancre at the period of progress is the *only* source of the syphilitic virus." Indeed, it may fairly be asserted that a healthy woman, marrying a man who has had syphilis but in whom all symptoms have long disappeared, may give birth prematurely to a dead fœtus, to a stillborn child, or to an infant that will, either at its birth or within a few weeks subsequently, show symptoms of syphilis, all these results being the effects of syphilis transferred from the father. When both parents are similarly diseased the evidence is still stronger. "The semen of a diseased man deposited in the vagina of a healthy woman will, by being absorbed, and without the intervention of pregnancy, contaminate that woman with the secondary form of the disease, and that without the presence of a chancre or any open sore either on the man or the woman." (Dr. Porter, 'Dublin Journal of Med. Science,' 1857.)

Effects. Its propagation. Modes of propagation. Through semen.

A healthy woman, marrying a man who has had syphilis, but who has lost all symptoms of it, may acquire syphilis through a blighted ovum, or a series more or less prolonged of stillborn children, the placental circulation between the fœtal and maternal blood being the infecting medium.

Through ovum.

A healthy woman, giving suck to a child the subject of hereditary syphilis may acquire the disease through some fissure of the nipple, the disease locally and constitutionally manifesting its presence with all the intensity of a primary inoculation.

By suckling.

Again, the secretion of any true syphilitic sore, chancre, or mucous tubercle, whether of the mouth, nose, anus, vulva, or penis, is capable of transferring the disease; and the syphilitic poison may probably be simply absorbed by the vessels of a part—*physiological absorption*—without giving rise to any local affection. Hunter believed this, and Lane, Marston, and Lee have published observations that tend to support the theory.

Through secretion of any sore. Physiological absorption.

"It should never be forgotten that it is the virus which infects the system, and that the sore is the mere local lesion, and not a necessary antecedent to infection." (Committee on Syphilis, p. 8.) "It is impossible to predicate with absolute certainty of any given sore that it will or will not be followed by constitutional infection." —J. Lane.

It should never be forgotten that the poison of syphilis, introduced into the system, in whatever way, whether inherited or acquired from primary sores or from the secretions of a syphilitic subject, is the same and manifests its presence in much the same way.

It may be difficult in individual cases to make out the direct source of the contagion; but if we recognise the fact that the virus, however

Source of contagion not always made out.

diluted in one subject, may, when introduced into another, behave as if it had been taken from a spreading primary sore, the explanation of most clinical facts becomes easy.

Summary of the poison.

Syphilis is an animal and a human poison; it is capable of propagation from the secretion of any syphilitic to a virgin subject in all its intensity, by any form of inoculation; it may likewise be inherited. Nothing is known of its nature, although its effects are sufficiently familiar. The syphilitic virus, writes Bumstead ('Venereal Dis.,' 1870), "is alone capable of infecting the system at large and of affording protection by its presence against subsequent attacks. Unlike the poison of gonorrhœa and of chancre, it is not limited to purulent matter, but exists in the blood, in the fluids of secondary lesions, in the semen, and probably in other secretions."

How, then, it may be asked, is syphilis to be recognised? Is it to be recognised in its primary inoculation, or is it only to be known by its constitutional symptoms?

Can it be recognised by the sore?

It has been already stated that most authorities are agreed upon the fact that there is no form of local sore or chancre that can be said with certainty to be the result of the local inoculation of syphilis. In the cartilaginous indurated sore, with enlarged indurated glands, there is every probability of syphilis manifesting its presence; and in the multiple, suppurating, non-indurated chancre there is every probability of no such symptoms appearing. But in the first form such symptoms may not, and in the second they may appear. Consequently, as a law, this distinction becomes of little value. Indeed,

Only known by its constitutional effects.

syphilis as a constitutional disease can only be known by the manifestations of its symptoms, and not by the inoculation; in the same way as smallpox, when propagated by inoculation, is only to be recognised by the eruption, and not by the local appearances resulting from inoculation.

On acquired syphilis.

Acquired syphilis.

Cause.

Acquired syphilis is always contracted through inoculation from a chancre, or from a syphilitic mucous tubercle, condyloma, or other sore, or from the secretions of a syphilitic subject; the secretion of one form of syphilitic sore from one subject being capable of producing a chancre of another form in another subject.

Mr. John Morgan, of Dublin, by experiments, has been led to believe that "the discharge of a syphilitic female produces on *syphilitics* the sore identical with that produced from the soft sore or chancre."

Its appearance.

After inoculation a certain time usually elapses before the poison manifests its presence, which varies from six to twelve weeks. In exceptional cases, the symptoms of syphilis may appear within the month, or fail to appear for four or more months, but every week that passes after the third month without their manifestation lessens the likelihood of their appearance, and when six months have elapsed without syphilitic symptoms showing themselves the probabilities of their doing so are very slight.

The different forms of syphilitic inoculation will be considered under the head of chancre, &c.

Dismissing, therefore, the consideration of the character of the sore to which the poison of syphilis usually gives rise, with the simple reminder that there is positively no specific sore, the constitutional

symptoms of syphilis now claim attention; and the variety of forms they assume is very striking. They usually show themselves primarily upon the skin in the form of an eruption, or upon the mucous membrane of the alimentary canal, as indicated by sore tongue and throat, while some amount of fever and constitutional disturbance usually precedes their appearance, this "syphilitic fever" varying according to the nervous susceptibilities of the patient. Constitutional symptoms.

The skin eruption may be only a rose rash, *roseola*, giving rise to a mottling of the skin, or to a more lasting staining. It may assume the papular form, *lichen*; the pustular, *ecthyma*; the vesicular, *rupia*; the tubercular, ulcerating or non-ulcerating, or the scaly, *lepra*, or *psoriasis*. Bullæ are rare, except in hereditary disease; when present they indicate a cachectic condition. Eruption.

The mildest form of roseola may last but a few days and disappear, or leave a dusky coppery stain behind of some durability. Roseola.

The *lichen* will soon show the copper tint, and, as it flattens, may become a tubercle, and this a scale, the skin after the desquamation of the scale showing much the same as the macula of the rose eruption. Lichen.

When the eruption is tubercular at the first, the same series of changes will be seen; the raised, indurated or spongy tubercle, as it withers, usually showing a scale upon its surface, and then flattening down to a macula. Tubercle.

The *lepra* and *psoriasis* appear as inflamed patches more or less extensive, as in the non-specific forms, the epithelial scales varying in thickness and the fissures in depth. The psoriasis commonly appears on the palms of the hands and the soles of the feet. Lepra.

All these eruptions have a copper-coloured tint, more particularly after their first appearances have faded. But what is still more characteristic is the fact that upon the same subject several forms of eruption are often found together—the macula, papule, pustule, tubercle and scale, passing one into another. Copper-coloured tint.

What determines the form of the eruption at its first appearance is not known. Why syphilis in one man should manifest its presence by an eruption of mere maculæ, in another by a papular or scaly eruption, and in a third by a pustular, tubercular, or ulcerative form is not known. The theory propounded by Carmichael, that each sort of eruption has its own form of local sore or inoculation, was ingenious, but not supported by facts, and the generally received opinion is that the peculiarity or power of the infected patient has more to do with these phenomena than the nature of the poison itself. The pustular and vesicular eruptions are more prone to appear in cachectic subjects than in the robust, and an ulcerative action to accompany, or rather to follow their appearance; the base of the pustule or of the vesicle, and at times the substance of the tubercle, breaking down, and giving rise to a troublesome and spreading ulcer. Carmichael's theory not proved.

As the *outside* skin in syphilitic subjects is attacked by eruptions, simple and ulcerative, so the *inside skin or mucous membranes* are equally involved. "Every form of syphilitic affection of the skin," writes Lee, "has its counterpart in the mucous membrane; but the appearances will be modified by the comparative thinness of the structure, by the absence of cuticle, and by the little disposition these parts have to take on the adhesive inflammation." The mucous tubercle is Affections of the mucous membrane.

Mucous tubercle.

the more common form, and is found in organs of generation, tongue, mouth, lips, nose, palate, throat, rectum, and anus, and occasionally in other parts of the alimentary canal. It is known also in the larynx. At times these tubercles break down and ulcerate, giving rise to irregular excavated sores.

Rhagades.

Moist tubercles may appear in syphilitic subjects at any part of the body where two skin surfaces are in contact, associated with moisture. When they are found between the toes they are known as *rhagades*, and when about the orifice of a mucous passage as a condyloma.

Ulceration of throat.

Syphilitic sore throat may appear as a mere mucous patch upon the surface of the mucous membrane, or at times as an ulceration of this patch, while at others it shows itself as a distinct affection, the throat becoming swollen and of a livid colour, and rapidly passing into ulceration.

Varieties.

These ulcers may attack the soft palate, pillars of the fauces, tonsils, or pharynx, and present every kind of appearance, shape, and character. They may be serpiginous like the trail of a snake, horse-shoe shaped or circular, superficial or excavated with sharp edges, inflamed, sloughing, or indolent. By themselves they are not typical of syphilis, however suspicious, and other concomitant symptoms are required to determine the diagnosis.

Mucous patch.

The mucous patch is the most characteristic. No ulceration is typical, although the sharply cut excavated ulcer is the most unmistakeable.

In hereditary syphilis this form of excavated ulcer is rare, though I have seen the perforating ulcer of the soft palate in an infected infant a month old.

Syphilitic disease of the tongue.

Syphilitic disease of the tongue is a very troublesome affection, and manifests itself in a variety of ways; it appears more commonly in the form of aphthous and mucous patches, ulcerating or otherwise, and not unfrequently the whole thickness of the organ is infiltrated with the gummatous syphilitic material, either as an isolated nodule or as a general infiltration. When this nodule has softened down and suppurated a deep excavated sore or fissure may be left, not unlike that of cancer, and when this sloughs or is of a chronic nature the diagnosis becomes still more obscure. In cancer, however, there is probably a more marked local induration than in syphilis, and rarely a sharp well-defined edge. The history of the case is, too, very different.

Mouth, lips, nose, &c.

The mucous lining of the mouth, lips, nose, &c., is also equally liable to syphilitic disease, either in the shape of aphthous and mucous patches or of ulceration, not unlike that found on the throat or tongue; indeed the disease of one part of the mucous membrane is the same as that of all others, the local appearances and symptoms being modified only by the peculiarities of the part.

Ulceration of rectum.

In ulceration of the rectum syphilis bears an important part, and as a cause of stricture is not rare. When present, the disease usually spreads upwards from the anus, the bowel being in some cases superficially, in others deeply infiltrated and ulcerated. This form of disease is more common in women than in men (*vide* Chapter XVI).

Syphilitic disease of the periosteum.

Syphilitic disease of the periosteum shows itself in the form of nodes, and rarely as a single node. If the tibia be involved, several swellings exist, and the same occurs in other bones, particularly the cranium. The swelling is merely an effusion of the gummy material beneath the periosteum. When the bones are attacked the disease is mostly chronic, and too often ends in the death of the part, *i. e.* in necrosis.

In disease of the periosteum, extreme tenderness and pain with local swelling are the chief symptoms. When the bones are implicated the pain is of a constant aching character, and this is always aggravated towards night, but there is neither such swelling, nor so much tenderness, as in the periosteal affection. In disease of the bones of the skull, the dura mater and brain may become secondarily affected. Symptoms.

It must not be thought, however, that syphilis and its effects are confined to those parts of the body that come under the immediate notice of the surgeon. It is hardly probable that both ends of the alimentary canal should show evidence of the affection without some part of its intermediate twenty-five feet being implicated, or without some of the compound glands that are associated with it being involved. The pathologist knows this to be the case, and recent research has confirmed Wilks' observation ('Guy's Reports,' 1863), that "the extent of the influence of syphilis is only commensurate with the tissues of the body," and that "there appears to be scarcely a tissue which may not be affected, and always in one particular and characteristic manner." The internal organs may be affected equally with the external; not only the cranium, but the brain within it, or the nerves; not only the muscles of the limbs and tongue, but the heart; not only the pharynx, but the œsophagus; not only the larynx, but the trachea, bronchi and lungs, also the liver, spleen, and other viscera." Syphilitic affection of internal organs. Wilks' observation.

"The peculiar effect of syphilis on the system," says the same writer, "shows itself in a disposition to the effusion of a low form of lymph, or fibro-plastic material, in nearly every tissue of the body, occasionally modified in character to a slight extent by the organ in which it occurs. In solid organs or in the interior of the tissues there is found a more or less circumscribed deposition of an albumino-fibrous material, whilst on the surface of the body a similar material may constitute merely the base and border of an ulcer." In the testicle this is well seen (Fig. 12). Effects on the system

In these observations the whole pathology of syphilis is included, for whether syphilis involve skin, mucous membrane, connective tissue, muscle, bone, periosteum, or a viscus, the same exudation exists, either as an exudation and induration, or as an exudation breaking up with ulceration. Pathology of syphilis.

This exudation is the same in all stages of syphilis, in all tissues, in hereditary as well as in acquired syphilis. When the exudation is reabsorbed, a recovery is said to have taken place; when it breaks down, suppuration ensues. When it attacks the external tissues secondary symptoms are said to exist; when the internal viscera or the bones are affected, the symptoms are called tertiary. Exudation.

In cachectic and feeble subjects, where visceral mischief has a tendency to appear, syphilitic disease of the organs may occur.

Fig. 12.



Half a testicle affected with syphilis.
2351[58]. Prep. Guy's Hos. Mus.

Affection of bones and larynx.

The bones, if affected, are liable to become necrosed; the larynx, to ulcerate; and the skin, when affected, to suppurate as well as ulcerate. In fact, syphilitic disease in the feeble and cachectic is as liable to be associated with disorganising changes as any inflammatory or other affection. The longer the disease has existed, the greater also is the probability that the viscera and the tissues of the body generally will be involved. But in all other respects the effects of syphilis are the same. The virus, as it affects the body in all its different ways, is the same; at all times it is the same; the so-called *secondary* and *tertiary* syphilis are the same, for these terms have no definite signification. They have, I believe, tended to confuse the subject rather than clear it, and were framed when the pathology of the disease was but little known. Syphilis is clinically known by certain constitutional symptoms, and pathologically by certain morbid conditions. It may manifest its presence in different subjects in different ways, involving now one tissue, then another, with no apparent law regulating its action. In one patient a tissue may be involved early, in another late; but the node on a bone, the nodule of lymph on the iris, the indurated gummy tumour in the connective tissue or in a muscle, the puckered nodule of fibrous tissue beneath the peritoneal covering of the liver, the mass of fibre tissue poured out in a syphilitic testicle, are all alike. These differ only in their symptoms and effects according to their position, yet whether they occur soon or late after the primary inoculation, is a matter of no clinical importance.

Terms "secondary and tertiary" indefinite.

Moxon's views.

"While syphilis is thus unsparingly general in its attacks upon organs, yet it plays over much the same series of organs as other diseases; vulnerable or much-abused organs, which suffer disproportionately from common causes of disease, suffer also in much the same proportion from syphilis, while the thyroid, spleen, capsules, deep-seated bones, and, indeed, generally those parts which are not obnoxious to other 'common' diseases, escape also in syphilis" (Moxon, 'Med. Times,' June 24, 1871). In fact, beyond the local inoculation, syphilis fixes upon or rather attacks an organ much as any other disease, possessing no special predilection for one organ or tissue in preference to another; the so-called secondary and tertiary affections having no real difference, save only in the surgeon's mind.

Treatment of constitutional syphilis.

TREATMENT.—There is no remedy in the pharmacopœia that can be relied upon as a specific for syphilis, although there are many that have a very beneficial influence in aiding the disappearance of the symptoms; they can, however, do no more. It is, indeed, a question whether the disease is really ever cured, whether a person once under the influence of syphilis is not really like one brought under the influence of vaccinia, which means, that his body has been so affected by the poison as to be influenced by it for life. After successful vaccination a second inoculation rarely takes as it does in a virgin subject, and after true syphilis a second attack rarely if ever ensues, Porter's law being tolerably proved, "that the influence of syphilis never returns upon itself, or re-contaminates the source from which it had been derived" ('Dublin Quart.,' 1857). Ricord, Lee, and others have proved that the soft or non-infecting chancre is the only one that can be inoculated with success on the same subject. It is true that in a large number of cases syphilis appears to be cured, that the symptoms disappear and the health of

General remarks.

the patient is re-established; yet it is equally true that in such cases, after the lapse of years, even a quarter of a century, when, under some weakening influence by which the powers of the patient are reduced; by some local disease, such as an ulcer, the existence of former syphilis is again recognised. So long as the powers of the subject who had syphilis remain good, no evidence existed of its presence; but when these failed, the poison reasserted its claim to recognition. It must, however, be stated with considerable confidence that Nature, unassisted by art, seems incapable of eliminating the disease, or of arresting its progress.

On use of mercury.

In former times it was thought that in mercury the surgeon possessed a specific against the disease, and when all chancres were looked upon as syphilitic, and mercury was administered, a large proportion of supposed cures were recorded, no constitutional symptoms showing themselves.

In modern times, however, when it is known that at least three out of every four cases of chancres of the penis are local venereal affections and not syphilitic, the supposed success of the mercurial plan is not recognised; although in syphilis—that is, when the constitutional evidence of the disease is present—the power of mercury in getting rid of the symptoms is indisputable.

In strong and healthy subjects, therefore, when syphilis is present either in the form of skin eruption, sore throat, or other affection of the mucous membrane of the intestinal or respiratory tract, mercury is beneficial. The best mode of using it is generally supposed to be by inunction, the rubbing in of mercurial ointment, about the size of a nut, into the axilla twice a day, till the gums are touched, and after then only once a day. Dr. B. G. Babington recommended its being applied in adults to the soles of the feet, the rubbing in being performed by the action of walking. The internal administration in bark of the bichloride of mercury in doses of $\frac{1}{16}$th of a grain three times a day, is a good form of administration, as is also the green iodide of mercury in grain doses twice a day, with Dover's pill. Some surgeons still use the blue pill with opium. During the last five or six years I have been using the mercurial suppository twice a day, and have been greatly satisfied with its action; the drug acts as well this way as by the mouth, and in no way interferes with digestion or the functions of the abdominal viscera; indeed, I am disposed to think it by far the best mode of administering mercury. I know of no objection to its use. Next to this plan the calomel vapour bath is the best.

Mercury by inunction.

Given internally.

As a suppository.

Lee's calomel vapour bath.

The most convenient calomel vapour bath, writes Lee ('Holmes's Surgery,' ed. 2nd, vol. i), is one which was made at my request by Mr. Blaise. In this apparatus the lamp which sublimes the calomel boils the water at the same time. In the centre of the top, immediately over the wick of the lamp, is a small, separate, circular tin plate, on which the calomel is placed; around this is a circular depression, which may be filled one third with boiling water; the apparatus being placed on the ground and the lamp lighted. The patient then sits over it, with an American cloth cloak or mackintosh fastened round his neck. He thus becomes surrounded with calomel vapour, which he is generally directed to inhale for two or three separate minutes during each bath. In doing this the patient should not put his head under the cloak, but simply allow some of the vapour to escape from the upper part, and

breathe it mixed with a large proportion of common air. At the expiration of a quarter of an hour or twenty minutes the calomel is volatilised and the water will have boiled away—a portion of the calomel being deposited on the patient's body. The patient may then gradually unfasten his dress and put on his night dress, but must not wipe his skin. If he prefers it he may go to bed with the cloak and wear it. The bath ought to be used every night, and five or ten grains evaporated.

Bricheteau, Lewin, and Sigmond have employed the hypodermic injection of mercury with some success, throwing in 15 minims of a solution of corrosive sublimate, 4 grs. to the ounce of water. ('Brit. Med. Jour.,' 1869.)

Iodide of potassium.

For feeble cachectic subjects, however, mercury is ill adapted, and for such the iodide of potassium in five-grain doses, gradually raised to ten, or more, will do all that is needful. In London practice it is generally required to be combined with some tonic, such as bark, quinine, or iodide of iron. The combined use of mercury and iodide of potassium will occasionally be of great value.

When the mucous tracts are involved, the addition of some alkali such as the bicarbonate of potash, in ten-grain doses, to the iodide is advisable. The addition of the compound spirit of ammonia to the bark mixture is also useful.

When the symptoms begin to yield the treatment must be continued; indeed, the effects of the drugs, whatever they may be, should be kept up for at least six months after the disappearance of all symptoms, otherwise a relapse will ensue.

Comparison of mercury and iodide.

Comparing the effects of the two drugs together, it may be asserted that the mercurial plan of treatment is more applicable to the early than the late symptoms of syphilis; that in cases of relapses, or of a remote kind, the iodide of potassium is preferable, although under both circumstances in exceptional cases, one plan of treatment will succeed where another fails. When iodide of potassium cannot be tolerated, iodide of sodium may be substituted.

Diet.

During the course of syphilis the patient should live well, on simple, nutritious, but non-stimulating diet. Wine and beer should be given in moderate proportions, spirits never allowed, and smoking, as a rule, should be interdicted.

When mercury is being employed the skin should be kept warm and the feet dry, all sudden chills being bad. When suppuration or ulceration exists in any form of syphilis, mercury is rarely applicable, iodide of potassium combined with tonics is then the best drug, with or without opium. Sarsaparilla has no specific influence in syphilis; it is a pleasant vehicle, but nothing more. Opium combined with other drugs is at times of great value; with mercury it is invaluable; it may be given in small doses whenever the nervous system has been overwrought and there is great irritability of pulse. "The soothing qualities of this admirable medicine," writes Pearson, "can scarcely be estimated too highly." In spreading ulcerations, whether due to local or to constitutional causes, opium is invaluable, either given alone or combined with iodide of potassium. In such cases mercury is rarely beneficial.

Opium.

Treatment in affections of the mucous membrane.

The syphilitic affections of the mouth, tonsils, throat, tongue, &c., are expedited in their disappearance by the local application of nitrate of silver, chlorate of potash, or borax lotion, constitutional treatment being simultaneously employed.

The mucous tubercles of the genitals and other parts are most successfully treated by the local application of calomel, which should be dusted over the diseased surfaces through a muslin bag. A good rub with nitrate of silver at times expedites the cure. The parts should be kept well dry. Treatment of mucous tubercles.

Condylomata are not so amenable to the calomel treatment as the moist tubercles; they may, however, be successfully treated by the local application of nitrate of silver or sulphate of copper, by a lotion of bichloride of mercury gr. ij to the ounce of water, or of black wash. When the growths are very fleshy, excision is the best practice. Treatment of condylomata.

In ulceration of the throat iodide of potassium, in doses varying from six to fifteen grains three times a day, is of great value, with the local application of the nitrate of silver in stick or strong solution; a gargle of alum, chlorate of potash, or borax, a drachm to a pint of water, is also good.

In laryngeal disease the iodide must also be given quite as freely; and when ulceration has commenced, and seems to be unaffected by general treatment, tracheotomy claims serious consideration, because unless the larynx can be kept quiet, repair will not go on, and, so long as ulcerative disease is present, a sudden spasm of the glottis may occur and render imminent the death of the patient. The operation should, however, only be undertaken when the disease is steadily progressing in spite of treatment, and it is clear that the larynx will be destroyed as a vocal as well as a respiratory organ unless some steps be taken to stop its progress. Of these steps there are none equal to tracheotomy, for all surgeons are familiar with the fact that even under the most extreme conditions of disease repair goes on in the larynx directly the tracheal tube has been introduced, and physiological rest is given to the organ (*vide* paper by author, 'Clin. Soc. Trans.,'1868). Treatment in laryngeal disease. When tracheotomy advisable.

In the *gummy tumours* of the tongue, muscles, and cellular tissue, large doses of the iodide with tonics are as beneficial as they are in the *periosteal* affections of syphilis. Treatment of gummy tumours.

There is reason, however, to believe that in the visceral as well as in other diseases which may be looked upon as the sequelæ of syphilis, or as the result of the cachexia caused by the disease and the remedies employed for its removal, iodide of potassium alone has little influence. Dr. Wilks has shown how the lardaceous and waxy diseases of organs are found after syphilis, and every one knows how little amenable to treatment these affections are; Dr. Dickinson has, however, done something to prove that they are due to a want of alkalinity in the blood, and are to be prevented and, in a manner, cured by the medical use of alkalies. With the same view a non-nitrogenous diet should be allowed. Treatment of internal syphilis.

During the later period of the disease, when the gummous depositions take place, whether it be visceral, osseous, glandular, or otherwise, iodide of potassium in full doses is of great value. In the sequelæ, in waxy or lardaceous disease, it is of little use, alkalies with tonics being then apparently the best. Upon this knowledge it is probable that the late Mr. Aston Key based his advocacy of lime water and the infusion of sarsaparilla in the syphilitic cachexia. When iodide of potassium of value.

Hereditary Syphilis.

That syphilis is capable of being propagated by hereditary transmission is a clinical fact generally recognised, constituting the main On hereditary syphilis.

distinetion between syphilis and all other animal poisons. To what an extent tbis influence sprcads is still a debateable question. According to some observers, instead of diminishing, tbe radius of its action appears to bc yearly increasing.

Probabilities of transmission.

That the child of a parent who has had syphilis *may, not must*, inherit the disease is generally acknowledged, and, when both parents have been affected, the probabilities of its transmission are, doubtless, increased; but data are still wanting to determine under what circumstances the offspring of such parent or parents is likely to be thus affected, or to he born healtby, and, wbetber maternal or paternal influence is the greater.

Tbere is, however, some reason to believe that when tbe mother is at fault the early conceptions are more likely to be blighted, and tbe later come to maturity; whilst when the father is at fault tbe first conceptions show few, if any, signs of the affection, the symptoms becoming more marked in eacb succeeding one, till at last the ovum becomes blighted and tbe wife constitutionally affected.

Daily experience proves, bowever, that a man who has had syphilis and lost all traces of it under treatment, who enjoys good health, and marries a healthy wife, may he blessed with healthy children. in whom no traces of sypbilis can be found; and the same experience also indicates that like subjects, marrying in a less vigorous condition of health, or lapsing into it, may give rise to diseased offspring. Tbe probabilities of the child being affected, as well as the degree of tbe affection, turn much upon the period of time which has elapsed between tbe disappearance of the constitutional symptoms iu the parent and the date of marriage.

Lancereaux's views.

A certaiu number of children, writes Lancereaux, succumb in tbeir mother's womb to syphilis, solely because they are already affected witb the disease. At other times the children come into the world with lesions unmistakeably syphilitic; while in the great majority of cases the child who inherits syphilis has at first tbe appearauce of healtb, and, some weeks after birth, presents signs which betray the evil transmitted to it from its parents, it being usually from the first to the third month of extra-uterine life that syphilis manifests itself in the newborn child. Cullerier, however, gives a year as tbe latest time for the disease to show itself.

Symptoms of hereditary syphilis.

Witb respect to the symptoms of hereditary syphilis, it may be well to assert at the beginning, that, with the exception of the primary inoculation, they are much the same as those of the acquired disease. Affectious of tbe skin are found associated witb those of the mucous membranes, bones, or viscera; and tbese manifest themselves in uo definite order.

At birth the child may be plump and fat, and for some days appear healthy in every respect. After tbe lapse of a few days some difficulty in breathing will probably appear, with symptoms of cold iu the head,

"Snuffles."

these so-called "*snuffles*" being always suspicious. At this time, if the skin be carefully examined, more particularly about the buttocks

Eruption.

and feet, some eruption will be seen. This may be simply a staining of the skin, or a more definite papular, vesicular, or pustular rash; it may be associated with some affectiou of the internal skin or

Condylomata.

mucous membrane, mucous patches, or condylomata showing themselves at the anus, about the mouth or within it, arouud the nose, or other

parts. The seat of the eruption is greatly determined by the degree of cleanliness observed, the irritation of dirt and moisture in any locality in syphilitic children being followed by condylomata or mucous patches.

The orifices of the nose, mouth, and anus are at times fissured in a very marked manner, and occasionally exhibit manifestations of the disease which can never be mistaken, even years afterwards. In the annexed drawing these alterations about the face are most typical (Fig. 13). Fissures at orifices.

When the disease is allowed to run its course the child's general condition suffers, it becomes emaciated and puny, the digestive organs become deranged and refuse to assimilate food, however good; while vomiting and diarrhœa are common consequences. Evidence of starvation soon appears, the skin becomes baggy, and of a peculiar dusky hue; when not covered or scarred with eruptions it may have a jaundiced appearance, and the child will probably die from what is called marasmus, which means wasting from starvation. Emaciation.

When the disease does not run so rapid a course, other symptoms show themselves. It may be in the skin, bones, eye, ear, or viscera.

In the *skin*, subcutaneous, or submucous tissues, the disease may appear in the form of *gummy swellings* or *tumours*, which may break up and give rise to irregular excavated cellulo-membranous abscesses. In the *bones* the disease may show itself as nodes, the humerus appearing to be the bone most commonly affected, though I have seen several instances in which the bones of the skull were frightfully involved. Affections of skin, &c. &c.

Fig. 13.



Hereditary syphilis, from life.

In the eye the symptoms are well known; the *interstitial keratitis*, a form of disease, according to Hutchinson, which is peculiar to hereditary syphilis, generally shows itself between the ages of eight and fifteen years. It appears as a diffused haziness of the centre of the cornea, unattended with ulceration; this haziness begins in independent patches, which subsequently coalesce, the cornea, at a later date, appearing like ground glass. The affection is attended with photophobic pain about the orbit and sclerotic injection. It generally involves both eyes seriatim. Under treatment the disease may be arrested, but when it is severe, patches of haziness remain which interfere with vision, and at times cause complete blindness (Fig. 13). Interstitial keratitis.

Iritis is also another complication, though a rare one, as is *choroiditis* and also *amaurosis*.

Deafness is not unfrequent, the hearing failing without any external disease, such as otorrhœa. In most cases both ears are affected. Deafness.

Hydrocephalus and syphilis are also allied. *Syphilitic* disease of the Hydrocephalus.

Disease of testis.

testicles is also to be met with. I have seen several cases of this nature, and the most marked was in a boy, the third child of syphilitic parents, four months old, who had snuffles and mucous patches on the lips. Each of the testicles was an inch and a half long and very hard. The disease was cured by mercurial treatment.

There is reason to believe, moreover, that in hereditary, as in acquired syphilis, every organ of the body, in different cases, may be found diseased, the viscera of the cranium, thorax, and abdomen, with the glands generally, as well as the skin, mucous membrane, muscles, nerves, and bones.

Exceptional cases.

How far the syphilitic poison follows the subjects who inherit it is difficult to decide. It is no uncommon event to find a child, entirely free from all evidence of constitutional syphilis, born of parents who had previously given and may subsequently give birth to stillborn or diseased offspring. A healthy child may stand alone in a long series of conceptions as a living proof of the power of life even over such a poison as syphilis.

I have also before me the notes of an instance of twins born of syphilitic parents; one passed through all the series of complaints common to hereditary syphilis, while the other escaped altogether, that is, at the end of a year and a half no symptoms had appeared.

I have the notes of another case of twins, born under like circumstances, in which the symptoms appeared in one at the end of a month, and in the other in the fourth month.

Explanation of such cases.

Such cases as these would appear to show that the manifestation or non-manifestation of the symptoms of hereditary syphilis depends much upon the personal power of the child who inherits it, a strong child throwing off or eliminating the poison, while the weak falls under its influence; since in the case of the twins above mentioned there can be no question as to the similarity of the conditions under which they were placed. In hereditary syphilis this conclusion is founded upon strong evidence, and in the acquired it is at least probable.

Amongst the evidences of hereditary syphilis established by Mr. Hutchinson there are often present in the permanent teeth important indications, so important, indeed, that, when present, the existence of

Fig. 14.



Syphilitic Teeth.

Fig. 15.



Healthy Teeth.

hereditary syphilis may with some confidence be pronounced. They, however, exist only in exceptional instances of hereditary syphilis.

Affections of the teeth.

"*The central upper incisors of the second set are the test teeth*;" these are usually short and narrow, with a broad vertical notch in the

edges, and their corners rounded off (Fig. 14); horizoutal notches having nothing to do with syphilis.

"Next in value to the malformation of the teeth," writes Hutchinson, "are the state of the patient's skiu, the formation of his nose, aud the contour of his forehead; the skin is almost always thick, pasty, and opaque. It also shows little pits and scars, the relics of a former eruption, and at the angles of the mouth are radiating linear scars, running out into the cheeks. The bridge of the uose is almost always broader than usual and low, ofteu it is remarkably sunk aud expanded. The forehead is usually large and protuberant in the regions of the froutal eminences; ofteu there is a well-marked broad depression a little above the eyebrows. The hair is usually dry and thiu, aud uow and theu the nails are broken and splitting into layers. Iuterstitial keratitis is pathognomouic of iuherited taiut, and when coiucident with the syphilitic type of the teeth, the diagnosis is beyoud a doubt." Hutchinson's account.

Iu Fig. 13, every poiut in this description is illustrated except with refereuce to the teeth, which were unusually good.

TREATMENT.—To help the disappearance of the symptoms of hereditary syphilis, remedies are of great value, and in an infaut showing evidence of auy constitutional power, the prospects of a recovery are very good. When the child is beiug suckled, whether the mother shows symptoms or uot, I administer my remedies, and have done so for many years, through the mother, giving her from six to ten, or sixteen grains of iodide of potassium with quinine, or other tonic mixture, three time a day, half au hour before the child is put to the breast, aud I have been much impressed with the excellent results of the practice. Treatment of hereditary syphilis. When child is sucking.

When this process acts slowly I give the child iu addition a grain of grey powder, with three or four graius of dried soda, every night. Before this I administered the grey powder and soda twice a day, or rubbed in about ten graius of blue ointment every night on the soles of the child's feet, the abdomen, or the axilla, but I much prefer the practice previously laid down. Iu young infauts the mercurial ointmeut may be put on the belly-band, and thus rubbed in. As the snuffles disappear, the eruption and mucous tubercles fade, and the child begins to fatten and show signs of progress. The treatment should be kept up for at least a month after the disappearance of all symptoms. Mercurials.

The chlorate of potash treatuent in some instances is doubtless atteuded with no unfavorable result, strong infants with care and uursing battling through the disease and possibly eliminating it. But the weaker die, when through more active measures they might probably have been saved; for many apparently hopeless victims of hereditary syphilis become under treatment strong and healthy infants. Chlorate of potash.

A child with hereditary syphilis should under no circumstauces be suckled by any other than the mother, for mauy a healthy wet nurse has been inoculated by such a criminal practice. When the mother cannot attend to the child it should be brought up by haud.

Serpiginous ulceration.

This is a rare and somewhat singular form of veuereal disease. It would seem to be more closely conuected with the local suppuratiug non-syphilitic sore than the syphilitic, for it is rarely if ever associated with constitutional syphilis. It usually appears iu the groin or thigh after a suppurating bubo the result of a suppurating, non-syphilitic Serpiginous ulceration. Characters.

chanere; the opening in the groin spreading in ereseentic patches of ulceration, one part of the sore increasing while a second is healing; when the cicatrix forms it presents a smooth glazed appearancc. This uleeration is most obstinate, indeed, medicinc appcars to havc little or no influence on its progress, and it may so spread as to extend over the thighs and lower part of the abdomen, and continue at intervals for years, but wearing itself out at last. I have seen one case in which it spread as high as the umbilicus and as low as the knec. The disease at one time promises to heal and then spreads without any clear cause. It is often found, too, in apparently healthy subjects, and appears to follow some course of its own that is not yet understood. It should be added that this sore is capable of being inoculatcd upon the same subjcct, the point of inoculation taking on the samc action.

Capable of inoculation.

Treatment of serpiginous ulceration.

TREATMENT.—Mercury and iodide of potassium appear to have little or no influence on this malady; and if the view indicated by its course be correct, that the disease is not syphilitic, such a result is only what should be expected. The local treatmcnt of the sore seems to be the most important, and the best practice consists in the local application of some strong eaustic, such as nitric acid, carbolic acid, or the cautery, either galvanic or actual, the patient bcing under the influence of some anæsthetic. Opium in moderate doses is of use, and so also are tonics, but in a general way the subjects of this affection are in good health. In several instanees I have found a sea voyage of more value than any other treatment. In thrce cases the sore rapidly healed after the operation of skin grafting had been performed.

Question of marriage after syphilis.

When may a man who has had syphilis marry? is a question which is often asked, and, to answer it with any degree of confidence is no easy task, assuming, as I do, that the opinions laid down in these pages are correct, that a mau who has once had syphilis is never free from its influence, and that the poison once in the body may reveal its presence a quarter of a century after all external evidence of its existence in the form of local disease has disappeared.

A man who has had syphilis may, therefore, when he marrics, so affect the ovum of his wife as to eause its death, or produce some evidence of disease, or fecblcness; or if the wife be healthy and he himself in good condition and free from evidence of the disease, the offspring may escape altogether and appear as healthy as that of other uninfected parents. Indeed, it would appear that if a man marries when in robust or good health a year after all evidence of the disease has vanished, hc may be the father of a healthy child; but if his general condition fails and hc bccomes cachectic the poison secms to have the power of reasserting its influence and manifesting its presence by some feeble or even diseased condition of the subscquent offspring.

When the mother is affected with the disease the same risks are run.

Every parent who has had syphilis runs the risk of giving birth to feeble or diseased offspring; these risks are diminishcd by the general vigour of the parents, and incrcascd by diminished power. No man should marry so long as the slightest taint of the disease manifests its prescnce, but if in good health, and frec from all evidence of its presence for a year, marriage may be contracted. To ask for a longer dclay when such a step is contemplated is unfair and unnccessary; a risk must be run, and the lapsc of a longer period will not lessen it.

Inoculation and Syphilisation.

Ricord was the first surgeon who employed inoculation for diagnostic purposes in venereal affections; and through his experiments he was led to the conclusion, that "a chancre at the period of progress is the only source of the syphilitic virus." As a test of the simple suppurating sore it may now be employed, for a second sore can readily be obtained by inoculating a patient from the pus of his own primary one. Indeed, this process of auto-inoculation may be continued for a long series, but only with any effect from the suppurating sore. In the syphilitic sore no inoculation will take, and in the inoculation of common pus no reaction occurs, or next to none, a simple pustule probably alone appearing. On inoculation and syphilization. Clinical facts.

From these clinical facts it would appear that common pus, the pus from a suppurating non-syphilitic sore, and that from a syphilitic one, are very distinct, including under the term syphilitic any sore that is followed by syphilis.

By inoculation, therefore, a surgeon may fairly determine the fact as to the nature of a chancre, and, under some circumstances, the evidence obtained by the practice may be valuable.

Syphilisation originated in 1844 through some experiments of M. Auzias Turenne upon animals to inoculate them with syphilis; and in these he found, that, after a number of inoculations, they became proof against the syphilitic virus. It was followed up by M. Sperino, of Turin, and extensively employed by Professors Boeck, Faye, and Bidenkap, at Christiania, several hundred cases having been treated upon the principle, the object being "to cure syphilis." Syphilisation.

The theory as expressed by Boeck, "that the syphilitic virus, by continued inoculation, annihilates itself," was practically carried out by inoculating a patient the subject of syphilis with fresh matter from any active venereal sore of any kind till the inoculations failed to take. The inoculations were repeated every three or four days, first on the body, then on the extremities. When inoculation is no longer possible, "the treatment is finished, and the patient has recovered his health." Theory thereof.

Boeck never practised syphilisation until the constitutional symptoms appeared, for, says he, "I cannot double a malady already present, so I am quite certain not to do harm to the patient." Syphilisation is not used with equal success against all cases of syphilis. "In those that have not been treated with mercury, the progress of syphilisation will be regular; the syphilitic phenomena will vanish away, immunity will take place eventually, and recovery be attained with certainty. In those who have taken mercury, syphilisation is not so certainly useful; it ought to be tried; it does often cure syphilis entirely, and at least does good." Boeck's opinions.

These are Boeck's conclusions; but I need hardly add, they are not those of British surgeons. The practice has been mentioned and briefly described, but not to be recommended. It has no single advantage, and is certainly loathsome. We are decidedly of opinion, write Lane and Gascoyen, in an able article on the subject, "that syphilisation is not a treatment which can be recommended for adoption. We consider that, even if it could be admitted to possess all the advantages claimed for it by its advocates, its superiority over other modes of treatment, or in many instances over no treatment at all, would not sufficiently compensate for its tediousness, its painfulness, and the life- The treatment not to be recommended.

long marking which it entails upon the patient." ('Med. Chir. Trans.,' vol. 1.)

Vaccino-syphilis.

Vaccino-syphilis.

That syphilis may be transferred by means of vaccination is a fact which must be honestly recognised, although where it has occurred it seems more than probable that something more than the unmixed lymph of the genuine vaccine vesicle had been employed, such as the blood of the vaccinifer; for no one can now well dispute the possibility of inoculating syphilis when the blood of a syphilitic vaccinifer is transferred with the vaccine matter to a non-syphilitic subject. Whether it be possible to transfer syphilis through unmixed vaccine lymph is still an open question. In this country, such a misfortune as a syphilitic inoculation through vaccination has been happily rare, and only in recent days has the attention of the great body of the profession been directed to the subject. In Mr. Hutchinson's paper, and in the report of the Med.-Chir. Society for 1871, there will be found sufficient material to prove the truth of what has been written; and in Dr. Seaton's 'Handbook on Vaccination,' and in Dr. Ballard's work, all that is known on the subject may be ascertained.

References.

Prevention.

To guard against the possibility of repeating these errors, the vaccinator should be careful to transfer only the unmixed vaccine matter; he should select also, when possible, a healthy vaccinifer, who is the second child of a woman whose firstborn is healthy, and in whom there is no history of miscarriages. When any suspicion of syphilis exists in either parent, the child of such parents should be set aside and not used as a vaccinifer, however healthy and perfect the vaccine vesicle may be. The cleanest instrument should be used, and the same should never be employed for a second operation until washed. It would be also well, for the purpose of keeping up a good supply of vaccine, occasionally to vaccinate direct from the heifer.

With these precautions vaccination may be regarded as a perfectly safe operation. Without them the risks of syphilitic inoculation, although slight, exist. They tell, however, but little against the enormous advantages of vaccination.

Lee, 'Holmes's System,' ed. 2, vol. ii.—*Marston*, 'Med.-Chir. Trans.,' vol. xlv-vi.—*Lane* and *Gascoyen*, 'Med.-Chir. Trans.,' vol. l.—*Bumstead*, 'Edit. of Cullerier,' Philadelphia, 1868.—*Porter*, 'Dublin Quart.,' 1857.—*Lancereaux*, 'On Syphilis,' New Syd. Soc.—*Wallace*, 'On Venereal.'—*Carmichael*, 'On Venereal.'—*Hutchinson*, 'Syphilitic Diseases of Eye and Teeth.—'Report of Committee on Venereal Diseases,' 1868.—*Turenne*, Académie des Sciences, 1850.—*Boeck*, 'Edin. Med. Journ.,' 1858.—'Dublin Journal,' 1857.

CHAPTER III.

TUMOURS.

General remarks.

In the pre-pathological period, before the minute anatomy of healthy and diseased tissues was understood, and the microscope had rendered intelligible subjects that still rested in darkness, *tumours* had, from necessity, been studied simply in their clinical aspects, and surgeons, in their attempts to classify them, were guided solely by the most obvious characteristics of the growths, and by their real or fancied resemblance to the natural tissues of the body. As time advanced, more ambitious attempts at classification were made, and the most

important work was that of *Abernethy*, who at the beginning of this century published his 'Attempt to form a Classification of Tumours according to their *Anatomical Structures*.' In that able production he asserted "that the structure of a tumour is sometimes like that of the part near which it grows; and sometimes unlike; that in many cases the nature of the tumour depends on its own action and organisation, and merely receives nourishment from the surrounding parts." He thus gave expression to pathological truths of the greatest importance, and that still remain incontrovertible. The next real advance was due to Bichat, who recognised the essential difference between tumours and the parasitic nature of the cysticercus and echinococcus, although by his followers this parasitic notion was carried out far too fully, for they looked upon cancer as the product of a parasitic growth of entozoa. It was left, however, to Lobstein of Strasbourg, to embody Bichat's idea, and to give it full expression, which he did by naming those tumours *homœoplastic* which were similar in structure to the natural constituents of the body; and those *heteroplastic* which were composed of products which differ from the normal tissues. Since that time countless workers have been examining tumours and attempting to classify them—one of the most prominent being Lebert, and to him must fairly be attributed the credit of assigning specific elements to specific tumours, each tumour having, in his opinion, a definite structure; cancer was to be known by the caudate fusiform cells that even now are looked upon by some as typical of the disease. This notion of specific elements was very feasible, for it simplified knowledge and induced men to think they had a ready means of deciding upon the nature of any new growth; and, had it not been for Virchow it is probable the theory would have long held its ground. In this learned pathologist, however, it found an opponent of consummate power, and as his reasons for disbelieving it are the groundwork of his great book on 'Cellular Pathology and Tumours,' it is well to have them in his own words:

Abernethy's views.

Bichat's views.

Lebert's views.

"In Germany the doctrine of specific elements has from the first made few proselytes, and now it is entirely abandoned. From the commencement of my career I have been compelled to combat this error, and I believe that at the present moment we are in a position to demonstrate in every direction, that there do not exist in tumours true specific elements which have no analogy with the normal tissues. It is enough for that to remember that the tumour, however parasitic it may appear to be, *is always a part of the body from which it springs*, and that it is not developed in an isolated manner at the expense of some juice, at some one place in the body, by the inherent force of this productive juice. To admit such a mode of development, *de novo*, was possible at a time when it was also believed that entozoa were spontaneously developed in the body at the expense of a liquid or an excretion, by equivocal generation, when no idea had been as yet formed as to how a cysticercus arrived in the abdomen, and there was able to develop itself and grow. There was no other opinion which medical men could then form save that entozoa sprung from animal substances, either from the tissues themselves or from the intestinal mucus (*saburra*). In the present day, when it is known that entozoa always penetrates into the body from without, by a way, often it is true, extraordinary, yet always natural, this analogy can no longer be

Virchow's views.

invoked. This is still more evident since we have come to know that in a free exudation there is no new element produced; that, furthermore, the elements of the body itself have a legitimate origin from father and mother (or, to speak more correctly, from father or from mother, for it is a case of parthenogenesis), so that we must completely abandon the idea that a tumour can develop itself in the body as an independent being. *It is a part of the body;* it is not merely contiguous to it, but proceeds from it and is subject to its laws. *The laws of the body govern also the tumour.* This is the reason why it is not an object of natural history that one can regard as foreign from the elements of the body; it is, on the contrary, to be looked upon as embraced within its limits. Hair may make its appearance and grow at a place where we do not expect to meet with hair. But no one will fancy or believe that feathers will grow in the human body. As a matter of fact there are tumours in man which contain hair, and in cutting up geese, tumours are sometimes found containing feathers. But if ever a man engendered a tumour with feathers, or a goose, one with hair, this would be a production *sui generis*, because the thing produced would deviate from the type inherent to the individual.

Virchow's views continued.

"*The type which in general governs the development and formation of the organism, governs equally the development and formation of its tumours.*

"There does not exist a new, different, independent type.

"What is established by logic in this matter results also from the direct observation of tumours themselves. This is why I deny that there is any heterology in the sense in which it has been maintained since Bichat's time, or such as was supposed even before then, that is to say, that a tumour could develop itself and exist in the body in accordance with some quite new plan, some new law. I go further: each species of tumour, whatever it may be, answers in its important parts to the elements of the body, the type of which is known, and the capital difference amongst divers tumours resides in this, that tissues normal in themselves appear under the form of a tumour, sometimes in regions where this tissue normally exists, sometimes in places where it does not exist in the normal state of things. In the first case I speak of it as *homology*, in the second as *heterology*.

"Wherever a normal tissue appears at a point which already contains some similar tissue, then as a consequence the new tissue is identical with the old, so that the type of the new production answers to the type of the pre-existing tissue; in this case the new tissue, the tumour, is homologous; when, on the contrary, the new type does not correspond with the old one, when it deviates from the pre-existing type, or that which is the original and normal one of the region, then there is heterology. But this latter has likewise its analogue in the body, only in another part of the body from that in which the tumour is situated.

"We cannot, in my opinion, distinguish tumours according to the tissues, in such a fashion that tumours containing certain tissues are to be regarded as homœoplastic, whilst those containing certain others are to be set down as heteroplastic; quite the contrary, *the same kind of tumour may be, under certain circumstances, homologous, and under other circumstances heterologous.* The same sort of tumour may a

one time appear at a point where it is merely the expression of an excessive development of the tissue normally existing at this point, at another time at a place where this tissue is not in existence, and where its development is abnormal and strictly pathological. Let us take an example: a tumour may be formed of cartilage. The cartilaginous tumour is homologous, not because it is formed of cartilage but only if it springs from cartilage, if in this place there is cartilage already. Thus, a costal cartilage may be the point of origin of an enormous cartilaginous tumour: this is homology. But it is also possible for a cartilaginous tumour to be developed in the testis, which contains no cartilage, where this tissue should not be met with; here the same product constitutes an heterology."

On the terms homology and heterology.

Homology and heterology have, therefore, very different meanings as used by Virchow and other writers. In Virchow's language a tumour is *homologous* when it corresponds in structure with the tissue *in which it grows;* and *heterologous* when it deviates from that structure. A tumour that is homologous in one position may be heterologous in another. On the other hand, in the French and other schools a tumour is *homologous* when built up of elements naturally existing in some tissue of the body; *heterologous* when composed of elements that deviate from the natural structures, these definitions having nothing whatever to do with the position of the tumour. In Virchow's language the terms are relative; in that of other pathologists they have a definite clinical meaning of no slight importance, for homology means innocence and heterology malignancy in a tumour.

Virchow's views thereon.

Virchow, however, admits that his heterologous tumours are suspicious, although *every heterologous tumour is not of a malignant nature.* "There are a great many such tumours borne without any ill consequences, and whose properties are quite similar to those of which the nature is benign. Malignancy follows a certain scale among heterologous tumours, from species to species; and we are able to show how it is manifested more and more strongly—for the most part following two directions. In the first place, heterology is distinguished according to the degree which it attains. The tissues of connective substance have a much nearer relationship existing among themselves than they have with epithelial tissues or with the specific animal tissues. When, therefore, a cartilaginous or bony tumour is developed in connective tissue, or even a mucous tumour in adipose tissue, that is not nearly so heterologous as when an epidermoid tumour is formed in connective tissue, or a tumour of cylindrical epithelium in a lymphatic gland. A cartilaginous tumour which is developed in connective tissue, or in the tissue of bone, is indeed heterologous, but it is not so to the same degree as an epithelial tumour or a muscular tumour would be in the same place. But a still more important circumstance is this, that tumours engender certain liquid substances which we speak of under the name of juice. This is the humour or juice of the tumour of which much has been said."

"This parenchymatous juice is sometimes related to the cells, sometimes to the intercellular substance; and accordingly it appears under the form of fluid either intracellular or intercellular, contained in the cells or interposed among them in a liquid state like serosity. Whenever a tumour contains much juice, it gives evidence of more troublesome properties, and it possesses to a high degree the property

of infection. A dry tumour of the epidermoid kind is by far less dangerous than a moist one; a soft cancer is much more to be dreaded than a hard one.

Virchow's views continued.

"The more a tumour is poor in vessels the less it will extend its infecting action beyond the neighbouring parts; but the more it is rich in blood-vessels and lymphatics, the more it is traversed by the blood and lymph; the more the parenchymatous juices are in contact with the blood so much the more is the infection likely to become general.

On contagiousness of tumours.

"I give thus an interpretation of facts, but it is in accord with observation. The degree of contagiousness of tumours increases in proportion as they become more rich in vessels, and that alongside the vessels they contain an abundance of liquid materials. Every soft succulent tumour is suspicious, and that just in proportion as it contains many vessels and cells. The more the juice is intercellular and in contact with the vascular stroma of connective tissue, the more the malignant properties which are manifested by an ever new excitation to the progressive production of the tumour.

"I ought, indeed, to speak more at length as to the nature of these juices, but in truth I do not know what to say upon the subject. The results which chemists have arrived at on this subject have no kind of value. Here the field is open to inquiring and progressive spirits; and I hope that hereafter researches will be undertaken in this direction, and that they may be crowned with success."

But as this is not a work on pathology, I cannot allow myself to enter further into these speculations, and must refer the reader to Virchow's masterly work on 'Cellular Pathology and on Tumours' for a fuller elucidation of the subject.

Tumours regarded in their clinical aspect.

In the sequel I shall regard tumours in their clinical aspect alone, giving their anatomical characters only so far as they illustrate the practical aspects of the subject. All speculative pathological doctrines will be set aside, as tending to confuse rather than to elucidate clinical phenomena, until the day when pathological science shall have so far advanced as to allow of an anatomical classification of tumours being made that will fully dovetail in with that founded on clinical observation. The microscopical anatomy of tumours has been furnished by the pen of my friend and colleague Dr. Moxon.

I propose to lay down here some few pathological points which have an important clinical bearing, and which tend to illustrate the subject of the diagnosis of tumours.

Definition.

A tumour may be defined to be a new growth, cystic or solid, infiltrating, separate from, or continuous with, normal tissues. It is an addition to, not an increase of, natural parts, for such is an hypertrophy; and it manifests its independent existence by its disposition to grow irrespective of the part in which it is placed. All tumours with the exception of the hydatid, are made up of one or more of the natural elementary tissues of the body, in a rudimental or morbid state, and in no single example has any extraneous or new element ever been detected. For just as the natural body is built up of cells and fibres in one or other of their different forms, so tumours are made up of like elements, although it may be of unequal proportions. Tumours, like the natural tissues, differ therefore, anatomically according to the nature of the elementary structure of which they are

composed; and this again appears to be materially determined by the part of the body in which they are developed.

From this, therefore, a second leading principle may be fairly deduced, viz. *that all tumours partake of the nature of the part in which they are developed, and are more or less made up of the elements which naturally enter into its formation.* Deduction.

Hence a tumour developed in the stroma of a fibrous structure will probably be fibrous; if connected with bone more or less osseous; and if situated in a gland, it will in all probability partake of the gland structure. But new growths never assume the complicated structure of a fully developed gland, they only in a degree simulate it. Wilks well expresses it when he says that "the great difference between physiological and pathological formations appears to be that nearly all new growths are of the simplest composition, not putting on the form of the complex organs near which they may be placed, but consisting principally of cells and fibres." The cells and nuclei of a part, instead of developing into normal tissues, err in their course, multiplying and possibly growing, and "whilst conforming generally with the part in which they are placed in minute structure and composition, yet they more and more widely deviate from it in shape and size." (Paget.) Explanation. Wilks's remarks. Paget's remarks.

The practical bearing of these pathological principles is by no means unimportant; because to the surgeon who has once recognised the true position of a tumour, there is a certain amount of probability as to its nature, which will at once suggest itself to his mind. If the tumour is situated in the skin or subcutaneous tissue, a strong probability exists that it will be composed of some one or other of the structures of the tissue; thus it may be the sebaceous tumour, which is rarely found in any other position, or, the fatty, for these two materials enter largely into cutaneous structures; or, it may be one of the fibrous or fibro-cellular nature, fibre-tissue existing abundantly also in these parts. Should the tumour be located between the muscles of a part, the tumour will probably be composed of connective-tissue elements, in the form of a sarcoma; being either a myxomatous, fibro-nucleated, or fibro-plastic tumour. Should bone, again, be the seat of the disease, some one of the elements of bone will, to a certainty, enter into its formation; the probability of its being an enchondroma, an osseous or a myeloid tumour naturally presenting itself to the mind. And, lastly, should a tumour be present in a gland, such as the breast, uterus, or prostate, the probability of its being an adenoid or glandular tumour cannot be overlooked; for pathologists now all recognise the fact of the close resemblance of tumours so situated to the natural gland structure. Even in carcinomatous tumours, if modern recorders are to be relied upon, the same principle holds good, for according to Waldeyer ('Archives,' Band xli, 1868), "Carcinoma is essentially an epithelial growth, and only occurs primarily where true epithelium already exists. Secondary carcinomata can only be produced by the direct propagation of the epithelial cells, which may be transported from their primary seat either through the lymph vessels, or as embola are carried through the blood-vessels to a suitable place where they develop like the germs of entozoa." Practical bearing of the pathological principles.

Tumours are either simple or cancerous, innocent or malignant; the simple or innocent approaching, in their nature, to the more highly organised natural structures of the body, even to the perfect glandular; and Division of tumours into two classes.

the malignant or cancerous simulating the more elementary or embryonic. As the normal tissues were formed from a simple cell, and in their higher grades are but a development of that cell or those cells, so the cancerous element consists in a persistence of the simple cell type or that of the undeveloped embryonic nucleus. The group of cases called "recurrent" must be placed in an intermediate position, for while in their earlier stages they tend to build up embryonic tissue, this subsequently becomes lost in cell proliferation.

On the cell elements in tumours.

In proportion, therefore, to amount of the cell element in a tumour its cancerous tendency may be determined, and the greater the proportion of the fibrous or well-developed structure, the greater the probability of its nature being innocent or simple. The more a tumour simulates the natural structure of a tissue or gland, the greater the probability of its being innocent; the more a tumour simulates the undeveloped cell structure, the greater the certainty of its being cancerous; malignancy appearing to diminish in proportion as the cells become more fully developed. As moreover it is in the nucleus of a cell that the active principle of its growth is to be sought, so it is clear that the more the tumour is composed of nuclei, the more malignant is its nature and the better the formation of the cell-wall the less malignant is the growth.

The nearer a new growth approaches, both in its elements and in the arrangements of its elements or structure, to the complex organs of the body, the greater are the probabilites of its being innocent; new growths under no circumstances equalling the perfection of a true gland tissue. Cancer being a purely cell tumour, growing indefinitely where the least resistance is met with, and having no other than cell structure, is, according to Wilks, "an objectless cell growth."

Cancer a purely cell tumour.

Tumours never change their original nature.

Tumours never change their original nature, nor pass or degenerate into others of a different kind. A simple tumour remains so to the end, and a cancerous tumour is cancerous from the beginning. The above lines are not intended, however, to convey the impression that a patient, the subject of a simple tumour, may not become the subject of a malignant one, or *vice versâ*, because such may unquestionably ensue; and after the removal of a simple tumour a malignant one may secondarily make its appearance. But no simple tumour by growth or degeneration will become malignant, as no malignant tumour will become innocent. It would, however, appear that in recurring innocent tumours there exists an increasing tendency in such growths to present on each return the elementary character of malignant growth and "that a tumour which, under ordinary circumstances, is lotb to contaminate the system may do so under the favouring influence of a long period of time," either as a recurring tumour or as a more malignant one.

Infiltrating process in tumours. Examples.

Simple tumours separate tissues in their growth, but never infiltrate cancerous, as a rule, infiltrate, and rarely separate. No more important practical point than the above can be adduced to aid the surgeon in his diagnosis of a tumour. A simple or innocent tumour however long it may be in growing, or large a size it may attain, will never do more than separate the parts between and beneath which it may be developed. The bones may be absorbed by its pressure, but they will never be infiltrated; and the skin may be so stretched and attenuated by its distension as to ulcerate or burst

but it can never be infiltrated with the elements of the tumour. This fact is well exemplified by a close-examination of the margin of a cutaneous opening, the result of over-distension; for it will appear as if cleanly cut, or rather punched at its edges, and never thickened or diseased. An intra-cystic growth may project from it as a fungus, and put on many of the appearances of a cancerous tumour, yet the margin of the opening will be free, and not infiltrated. In the cystic tumours of the breast this clinical fact is easily perceivable. (Fig. 406.)

Encapsuled tumours generally innocent.

Simple tumours, by expanding parts, cause the cellular tissue around to become condensed, and to form a capsule; consequently, most of the innocent tumours are encapsuled more or less completely. With the majority of cancerous tumours, however, a very different condition has to be described, for a cancer has the peculiar property of freely infiltrating all the tissues upon which it presses, at its base, round its borders, and upon its cutaneous aspect. As the tumour approaches the surface, the integument first appears to be drawn down to it, and afterwards seems as though glued to its surface (Figs. 399, 400). At a later stage, the skin becomes infiltrated with cancerous elements, feeling to the finger firm, fibrous, or tubercular; and when ulceration has commenced, the edges of the skin are palpably indurated, thickened, and infiltrated with cancerous products (Fig. 405). The contrast between these different conditions of integument in the two classes of tumours is most marked and very important, forming a very valuable means of diagnosis in the extreme stage of simple or malignant tumours.

Cancer infiltrates skin, &c.

Diagnosis of simple and cancerous tumours.

Simple or innocent tumours affect the patient solely through their local influence. They grow by their own inherent properties, irrespective of the growth of the parts in which they are placed; have little disposition to soften down or ulcerate, and no tendency to multiplication in other tissues, or to involve the absorbents with which they are connected. Cancerous tumours not only affect the patient through their local influence, but have a marvellous tendency to multiplication in any part of the body. Through the lymphatic system they involve the glands of the part with which they are connected, while through the vascular system they spread to other parts. They are prone, also, to degenerate and ulcerate.

When simple tumours are multiple.

When simple tumours are multiple, they invariably are found in the same tissue. When cancerous tumours are multiple, they are mostly found in different tissues. Thus, amongst the innocent growths, multiple fatty tumours of the skin are not uncommon; multiple fibromata of the uterus are often seen; multiple glandular tumours of the breast are met with involving one or both organs; and there are records of multiple fibroplastic or myxomatous tumours. It is not seldom that multiple enchondromatous tumours and exostoses are seen; but in all these instances the tumours occupy one tissue.

When cancerous tumours are multiple.

In the cancerous multiple tumours no such description can be given, for they spread in ever widening circles from the parent tumour, the cancerous elements spreading locally in connective tissue as freely as the floating blood-cells move through the walls of the blood passages, as a colloid is penetrated by a crystalloid, wandering about in what are called solid tissues. They follow the course of the lymphatics and affect the glands, and at times seem to follow the course of the venous circulation. They recur by continuity of tissue as from constitutional

reproduction, and Mr. Moore, in his work on 'Rodent Cancer,' has referred to a case of Mr. De Morgan's, in which, from a cancerous tumour within the skull, some detached fragments, which had sunk in the fluid of the arachnoid, adhered to the spinal cord and grew. They spare no tissue or organ, but invade one and all, without order or law, in their destructive objectless growth.

Recurrent or intermediate tumours.

All tumours cannot, however, be divided into the *innocent* and the *malignant*, for there are some of an intermediate kind which in structure approach the innocent, but in habit the cancerous, as they *recur* after removal. They have consequently been called *recurrent* tumours; but, as the habit of recurrence is not the only point in which they approach the cancerous tumours, it is perhaps better to term them *semi-malignant*.

I propose, therefore to describe tumours under three headings:

1. Innocent;
2. Semi-malignant, or recurrent;
3. Malignant.

I. Innocent, or non-malignant tumours.

These may be divided into the "*Cystic*" and the "*Solid*," the cystic under certain conditions becoming solid by the development of intra-cystic growths.

Cysts are developed in many ways:

Cystic tumours, mode of development.

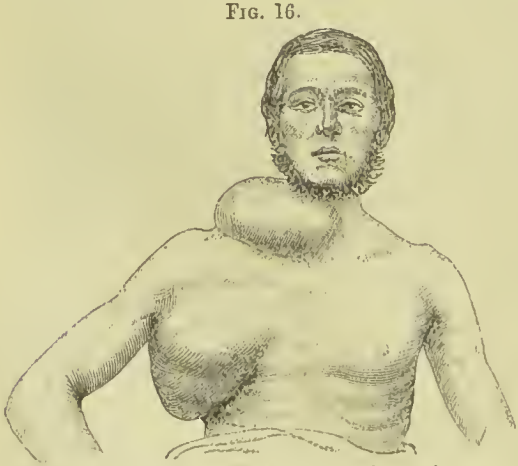
1. Some are possibly new growths or largely developed cells, having an independent life and being capable of secreting their own contents, or producing solid growths;—auto-genous cysts, as Sir J. Paget calls them.

2. Some are formed in an accidental way by the simple effusion of fluid into the spaces of connective or other tissues, the walls of these *false cysts* gradually consolidating, as is commonly seen in hursæ and in ordinary tumours.

3. Others, again, are produced mechanically by the dilatation of occluded ducts or natural gland-orifices, the cyst enlarging by the secretion of the ducts or gland contents. Of these the mucous cysts of the mouth and vagina, the sebaceous cysts of the skin, and the milk cysts of the breast, are the best examples. Virchow calls these cysts by retention.

In many cases, however, it is impossible to ascertain how the cysts are formed.

Fig. 16.



Serous cyst of the neck. (Birkett's case.)

Serous cysts: situation.

Serous cysts are most commonly found connected with one of the vascular glands of the body, as the kidney, ovary, thyroid, or breast, but they are not rare in the connective tissue, and are found even in bones.

Characters.

When seen in the neck

they are described as "*hydroceles of the neck*." Some of these are congenital, but the majority occur later in life. They appear as single or multilocular cysts, made up of thin membranous walls, lined with pavement epithelium. Like a serous membrane they contain a limpid, watery, or tenacious highly albuminous fluid, more or less stained with blood, occasionally holding cholesterine in suspension. These cysts are found in the neck, anywhere between the lower jaw and clavicle, beneath which they at times pass (Fig. 16); they are usually deeply seated, and occasionally superficial; they give annoyance only from their size, and are painless; when inflamed, they may suppurate. They are recognisable by their globular cystic form, soft fluctuating feel, and painless increase. Diagnosis.

These cysts are not to be confounded with those of the *thyroid gland*, which are far more common, and at times attain a large size, growing as quietly and painlessly as do the cervical. Usually, however, they have thicker walls, are more tense, and are commonly multiple; moreover, they move up and down with the gland on deglutition. Their contents are more viscid and frequently mixed with blood in variable proportions; indeed, some of these thyroid cysts are *blood cysts*, which when tapped would go on bleeding if allowed, even to the death of the patient. I have recorded such a case ('Guy's Reports,' 1864). It is probable, as Sir J. Paget has suggested, that many of the cervical cysts are thyroid in their origin, springing from some outlying portion of the gland. Not to be confounded with thyroid cysts.

Cysts are also found over the thyroid cartilage, but these mostly contain grumous blood, and rarely grow larger than half a walnut. In a case under my own observation, a cyst completely covered the thyroid cartilage, and was lost on either side in the deep tissues of the neck. It existed in an adult man as a soft fluctuating swelling, and had been growing for some years as a painless formation.

Cysts which are possibly bursal, are likewise found in connection with the hyoid bone.

Treatment.—Cervical cysts had better be left alone, unless from their size they require surgical treatment, because there is always danger in dealing with any deeply seated cyst in this region from the liability of subsequent diffused inflammation of the cellular tissues of the neck. I lost a patient, some years ago, from this cause, after simply tapping the cyst. Treatment of cystic tumours.

When surgical treatment is called for, *palliative* means had better be primarily adopted. This treatment consists in merely drawing off the contents of the cyst by means of a trocar and canula, or the "aspirator." Should the fluid re-collect rapidly the operation may be repeated. In performing this operation the surgeon must guard against puncturing any of the superficial veins or deep vessels, and should recall their position before puncturing. Palliative.

Should these measures fail even after several repetitions, the best practice is to introduce into the cavity of the cyst a drainage tube made of perforated india-rubber. When the tapping has induced some suppurative action the opening may be enlarged and the tube inserted, but when the cyst is large it is well to pass the tube completely through it. This may readily be done by means of a long trocar and canula, such as that employed for puncturing the bladder per rectum, the pilot trocar being intro- Tapping.

duced into the cyst after it has been opened at a dependent point, and then made to traverse the cyst, possibly beneath the sterno-mastoid muscle to the opposite side. The pilot trocar should then be removed, the drainage tube passed through the cannla, and the canula taken away, the two ends of the tubing being fastened together to prevent its slipping out.

Points to be attended to in tapping.

I have treated many cases of deep cervical cysts in this manner with success. The great point to attend to is the free escape of all pus and cyst contents; if air gets in, let the opening be free enough for it to pass out. Should fœtor appear, the cyst should be washed out daily with Iodine lotion, Condy's fluid, or some other disinfectant. As the cyst contracts the tube may be removed, but so long as any cavity remains, it should be left. The

Seton.

passage of a seton through the cyst is another method which may be adopted, and this is probably more suitable for small than for large

Injection.

cysts. Injecting the cyst with iodine is a third method which has proved successful, though it is as dangerous as any other, and not more

Extirpation.

successful. Extirpation of any large cervical cyst is a plan of treatment which should not be entertained, it is fraught with danger and difficulties.

Treatment of thyroid cysts.

Thyroid cysts may be tapped in the same way as the cervical, this simple operation being often successful for a long period, and at times permanently so. When more active treatment is called for, the injection of one or two drachms of the compound tincture of iodine or alcohol may be employed, according to the size of the cyst. When a *blood cyst* has been tapped, the flow of blood will usually cease on the removal of the cannla; and the tapping may cure it. In the cysts over the *thyroid cartilage* a puncture may be made, but when the fluid re-collects or is of a granulous kind an incision into the cyst in the median line appears the best practice. I have done this on several occasions with success, leaving a very slight scar. The treatment of cysts and tumours of the thyroid will, however, receive attention in another chapter.

Nævi may degenerate into cysts.

The student should remember that nævi, when they degenerate, commonly show cysts in their structure (Fig. 141); these are, however, usually clustered together in a cutaneous or subcutaneous group. When they appear in the neck they might be mistaken for one or other of the cysts already alluded to. This mistake will be prevented by remembering the fact that they do occur, and by the history of the case.

On mucous cysts.

Mucous cysts are found wherever mucous glands exist, and are caused by some obstruction to the escape of the gland contents. They contain highly tenacious mucus-like liquid albumen. They appear on the mucous membrane of the lips as *labial cysts*, and are small, tense, globular, painless swellings. They are found within the cheeks, upon the gum, particularly of the upper jaw and antrum, and very commonly beneath the tongue, as *sublingual mucous cysts*. Such

Ranula.

cysts have been usually described as cases of "*ranula*." They are now known to be due to obstruction of the ducts of Rivini's mucous glands and are not necessarily connected with the salivary organs (Fig. 191). Such a cyst may develope about the larynx, and cause obstruction, and such has been found in the œsophagus. They are common also in the labia pudendi, and also in the vagina. As *labial* and *vaginal mucous cysts* they appear as tense, globular tumours

beneath the mucous membrane of the parts. I have seen them as large as an orange. These cysts generally contain thick, ropy, mucoid fluid of a colourless or slightly yellow tint. Occasionally the fluid, too, is mixed with blood in different proportions. I have seen them contain black, milky, or coffee-ground fluid. Sometimes they inflame and suppurate, and run on into abscesses. Vaginal and labial cysts.

TREATMENT.—Small labial cysts may often be turned out as a whole on dividing the mucous membrane over them, but the sublingual and larger vaginal cysts, as a rule, cannot be thus treated. A free opening into them, and the introduction of a good plug of lint soaked in iodine to excite suppuration, may at times suffice, but not always. In the so-called ranula it may be tried before other practice is attempted. In the sublingual, labial, and vaginal cysts, I have for some years been in the habit of seizing the upper surface of the cyst with a pair of forceps or tenaculum, and cutting it off with scissors, thus freely exposing the deeper wall. In the sublingual this practice is, as a rule, successful without further treatment, but in the labial and vaginal cysts I have in addition generally destroyed them by the application of some caustic, such as nitrate of silver, to the exposed surface, after which the wound will granulate healthily. Treatment of mucous cysts.

When these cysts can be excised the operation may be performed. They must be destroyed or the secretion will go on.

The mucous cysts of the antrum and upper jaw will be described amongst the tumours of the jaw.

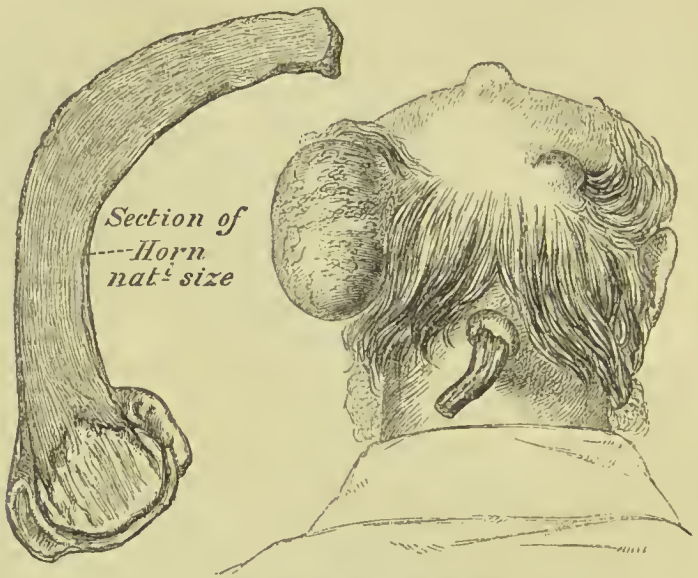
Cutaneous sebaceous cysts, as they come under the notice of the surgeon, appear as "*congenital*" and "*acquired*" tumours. They are analogous to the mucous cysts, the glands of the tissue being in both instances at fault. Some are doubtless caused, as first described by Sir A. Cooper, by the obstruction to the orifice of the sebaceous glands of the skin, for this occluded orifice may often be seen as a small depressed black umbilicated spot upon the tumour; the contents of the cyst may often be squeezed through this orifice, or into it a probe may be passed. In a larger proportion of cases, on making an attempt to raise the skin from the tumour, a dimple or some evidence of connection between the two will be visible, thereby revealing its nature. But in other cases no such obstructed duct or even cutaneous depression can be observed; and although the tumour may be developed within the integument, it is probably a new formation, an adenoid or glandular skin tumour. Cutaneous sebaceous cysts. Causes.

The congenital sebaceous tumours differ from those usually met with in the adult, or the acquired form, in that they are more deeply placed and mostly lying beneath the fascia of the part, occasionally beneath the muscles; they are rarely cutaneous. They are more common about the orbit and brow than any other part, the external angle of the eye being their favourite seat. They appear as small, hard, semiglobular masses deeply placed and are often indeed, upon the bone. Cases, too, are on record, in which, by their presence, they have produced perforation by absorption of the bone. In the ear this result is not rare. These cysts are thin-walled, and often contain liquid secretion; sometimes of a pearly whiteness, and not rarely mixed with hair. I turned a complete ball of hair out of such a cyst on one occasion, though usually the hairs are fine like eyelashes, and are mixed with the sebaceous matter. The contents of these congenital cysts are rarely offensive. Congenital sebaceous tumours.

The acquired sebaceous cyst.

The acquired sebaceous cysts may be found on any part of the body that is covered with skin. They are more common on the head and face than elsewhere, two thirds of all cases occurring in these regions: when on the scalp they are known as "*wens*" (Fig. 17). They are always surrounded by a cyst-wall, composed of fibrous tissue more or less dense, and which can always be seen after these tumours

Fig. 17.



Sebaceous tumours in scalp, and horn.

Wens.

have been enucleated from their beds. In "weus," however, there is a marked peculiarity which demands some notice. "The chief peculiarity consists in a thick dense horny capsule, which is closely in contact with the fibrous envelope of the original gland. This horny capsule was formerly regarded as the cyst-wall altered by pressure, until Mr. Prescott Hewett demonstrated its true relations and anatomical structure in his lecture at the College of Surgeons. It is now clearly proved that when one of these sebaceous tumours is squeezed out after the division of the skin, the fibrous cyst remains behind. This cyst can be afterwards excised, and its structure is identical with that of all the others. But the construction of the horny capsule requires explanation. If carefully examined, it is found to consist of epithelium, layer upon layer, mixed up with sebaceous matter. Sometimes a solid mass of epithelium is formed, in other instances a cavity exists in the centre, filled with soft sebaceous secretion. This capsule then seems to be a production of the epithelium of the sebaceous gland, which, being subjected to the pressure of the unyielding textures in which the tumour is developed, becomes converted by slow degrees into a tissue closely resembling horn or fibro-cartilage" (Birkett, 'Guy's Rep.,' 1859).

Construction of horny capsule.

These sebaceous tumours are more frequent in women than in men, and are, beyond doubt, hereditary. Sir J. Paget says "they are certainly more commonly hereditary than are any forms of cancer."

Follicular tumours. Characters.

Fungating and follicular tumours.

In neglected examples of sebaceous cyst the contents of the tumour may soften down, and, causing suppuration, may escape externally by ulceration. From the inner surface of the evacuated cyst a new growth may spring up, which, when forming an irregular, fungating, bleeding surface may at times put on an appearance which has been mistaken for cancer. On examining the edges of the wound, however, this mistake can scarcely be long entertained, as it will be at once observed that the edges of the wound are healthy, and not infiltrated with new matter, as would be the case in a cancer (Fig. 18). This fungating growth is really composed of exuberant granulations from the cyst itself, Abernethy recognised this when he said, "I have also seen after the bursting of an encysted tumour the surrounding parts indurate and throw out a fungus, forming a disease appearing like a cancer and which could not be cured." And "it is no uncommon circumstance to meet with wens that have burst spontaneously and have thrown out a fungus, which, like a fungous body, prevents the surrounding integument from healing."

Abernethy's account.

Fig. 18.



Fungating follicular tumour.

The best account of the affection is by Mr. Cock ('Guy's Rep.,' 1852.)

Treatment of follicular tumours.

Treatment.—The only correct treatment of these cysts, whether whole, broken, or fungating, consists in their removal. In removing "wens" or *acquired* cysts, however, it is not necessary to be too careful in dissecting them out entire, the most effective method being to slit open the tumour with a bistoury and then turning it out with the forceps or handle of the knife; the cyst-wall itself left is closely connected with the skin, but no harm follows. In the removal of sebaceous cysts from other parts of the body the capsule of the cyst should be taken away, while in the fungating tumour the whole ought to be excised. In the treatment of the *congenital* tumour it is always better to try and dissect out the cyst entirely; but nothing is more unsatisfactory than operating in such cases, for the cyst is always deep, its capsule thin and adherent, and any attempt to dissect it out, as a whole, is too often foiled by the bursting or puncturing of the capsule and the escape of its contents. When this occurs the surgeon must take away as much of the capsule as he can and then close the wound, a good result following, as a rule, though at times a recurrence of the growth will ensue.

Points to be attended to.

The fear of erysipelas after these operations is really almost groundless. It may arise, but out of more than one hundred cases consecutively observed, I have not seen one example. Pyæmia may follow this as it does any other minor operation, but not more frequently. When patients are cachectic, such an operation of expediency as that for the removal of a "wen" had better be postponed, for under low conditions of health blood poisoning is likely to follow. Should, however, its removal be urged,

When operation to be postponed.

this may be done by the injection into the cyst of some caustic, such as a few drops of deliquescent chloride of zinc, of carbolic acid, or the external application of nitric acid, or potassa fusa, to produce a slough through the skin, when the contents of the cyst may be turned or drawn out.

Caustics.

The dermoid cysts of the ovary are only of pathological interest, as are the dentigerous cysts of these parts. The dentigerous cyst of the jaw will be treated of in the chapter on diseases of the jaws.

Lipomatous tumours.

Fatty tumours, otherwise called lipomata or steatomata, are very common. They are found wherever fat exists naturally in the body; and, as this material is more especially deposited in the integument, it is in and beneath this that fatty tumours are most frequently met with. They occur at all periods of life, from infancy to old age, and are even congenital. They attack the male sex as well as the female but they are three times as common in the latter. They are generally single, but occasionally multiple. I have seen a case in which the whole integument was studded with them, and under these circumstances they are usually small. It is impossible to assign any valid cause for their development, hereditary and accidental causes having a doubtful influence. They are troublesome only from their position and the deformity they occasion (Fig. 19), and are at times the seat of pain, though such a symptom must be looked upon as an accident due to their position.

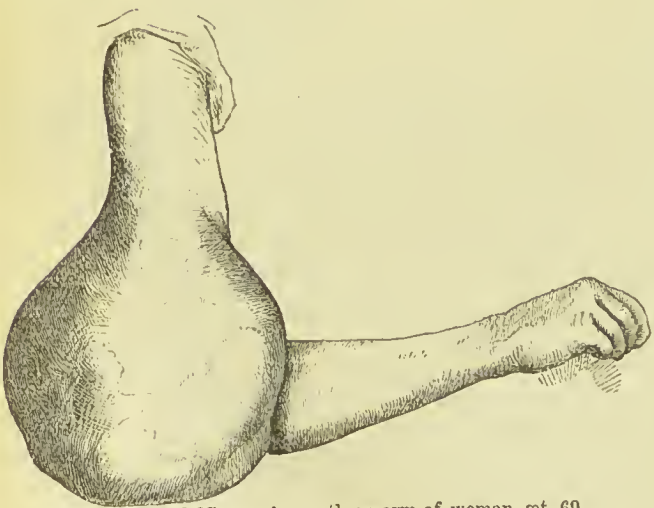
Causes.

Symptoms.

Usually encapsuled.

These tumours are, as a rule, "encapsuled;" although in rare cases they are "continuous" or "diffused." This latter variety differs only from the former in that they are made up of smaller lobules of fat, and are more dense, while they are more common about the nape of the neck and face than the encapsuled variety; the large double chin being an example of the continuous lipoma, and congenital lipomata are generally of this nature. The encysted lipomata are most common on the shoulder, thigh, and trunk; some are deep-seated, as between the muscles of the limbs, or within the abdomen, or scrotum. Fatty tumours at times shift their position, that is, they drop downwards; several such cases have passed under my notice, in which the tumour has travelled some distance. Such an occurrence is peculiar to this form of tumour, and suffices to fix its nature.

Fig. 19.



Fatty tumour of 37 years' growth on arm of woman, æt. 69.

Diagnosis.

The *diagnosis* is not usually difficult. If the tumour be deep a doubt may be felt, but, practically, the question is not of great moment,

for it only refers to the nature of a simple growth, and not to its treatment. If subcutaneous, these tumours are lobulated and encysted, that is, are defined by a distinct boundary, their cyst-wall being formed by the condensed fibro-cellular tissue in which they are developed. To the hand of the examiner the tumour will feel more or less firm, and made up of lobes; when frozen by the application of ice it becomes harder. To the eye the tumour will, on raising it from its base and distending the skin, appear dimpled, and in parts the skin will be quite drawn inwards towards the new growth.

Treatment. TREATMENT.—When no necessity exists for their removal they should be left alone. When large and unsightly, cumbersome or growing, they should be removed by excision. A single incision Excision. through the centre of the growth is the best and most expeditious method for turning the cyst out of its bed, which can be done readily by the finger. In dealing with the pendulous growths the whole should be cut off, leaving enough skin to cover the wound. After the operation the edges of the wound should be brought together by strapping and steady pressure should be applied; rapid union usually follows. Fatty tumours, when removed, very rarely return. Curling Barely recurrent. has recorded a case, however, in which a recurrence took place, but so much connective tissue was present in that example as almost to remove it from the class of lipoma ('Path. Trans.,' vol. xviii, 1867). I have also removed from the buttock of a lady a lipoma of two years' growth, the size of a fist, having removed from the same part a like tumour twelve years previously.

The "continuous" fatty tumour should never be removed unless When not to be removed. under very urgent circumstances. The operation is comparatively formidable, so much dissection being required. In children, however, these tumours may be dealt with.

Fibrocellular and myxomatous tumours. Fibrocellular tumours.

The term "*fibrocellular*" was originally given by Sir J. Paget in his classical lectures on tumours to a group of new growths or outgrowths made up of tissue more or less resembling the normal fibrocellular or connective tissue of the body, and the term "*myxoma*" has been applied Myxomatous tumours. by Virchow to the softer, looser, and more succulent or mucous variety of this group. Billroth calls this "myxosarcoma;" Müller collonema or colloid sarcoma. The typical *fibrocellular* tumour is firm, with Type of the fibrocellular. a homogeneous surface on section, and bands of delicate filamentous white fibre tissue intersecting its substance. Microscopically these bands are composed of fasciculi of delicate fibres of connective tissue which freely interlace; while elongated corpuscles and nuclei, varying in abundance in different specimens, are found within the fibrous meshes. The tumour is more or less œdematous, serous fluid on section draining away. In the typical *myxoma* the tumour is less firm but Type of myxoma. more elastic than the former; its nature is far less homogeneous, and presents less well-marked interlacing fasciculi of connective tissue, and from the meshes of this tissue will flow a variable stream of clear, translucent viscid mucus. The fibres of the connective tissue are visible under the microscope, but in smaller bundles and more drawn out. Abundance of cells, also rounded, elongated, branching, and even anastomosing, together with nuclei, will be found to fill the cavities formed by the confused network of delicate fibres of which the tumour

is composed. The structure of the tumour, says Sir J. Paget, closely resembles the embryonic connective tissue, or the Whartonian jelly of the umbilical cord. Between these two extremes many intermediate varieties are found in practice, the cell or the fibrous elements predominating in different proportions with the viscid mucous secretion. In the myxomata, fat often forms an important element in its structure; glandular elements may also be found, their presence being determined by the position of the growth and the propinquity of a gland. Bone or cartilaginous elements are at times mixed with the others. The fibrocellular tumours are mostly outgrowths, the different forms of softer polypi and cutaneous pendulous tumours being of this nature. The polypi of the nose are the best specimens of the looser kind of fibrocellular growths, as in consistence they vary from a watery pellucid pendulous outgrowth to a firm, more compact, and fibrous tissue. They are, however, always covered with mucous membrane with its ciliated epithelium. The softer tumours of the antrum are also of the same nature, as are the mucous polypi of the uterus, bladder, and rectum. In the rectum the fibrocellular tissue is intimately mixed with the glandular elements of the part. Amongst the fibrocellular outgrowths of the integument those of the male and female genital organs are the commonest. The tropical elephantiasis scroti is of this class. The pedunculated outgrowths of the skin are also of the same kind.

Intermediate varieties.

Examples of the fibrocellular.

Fibrocellular growths, as deep-seated tumours, are very rare. They do occur, however, in the connective tissue of the body, the intermuscular spaces of the thigh and arm being the commonest seat. They *are always surrounded by a capsule*, and, when not confined by unyielding parts, are more or less ovoid; at times they are lobed. They possess a smooth outline as well as an elastic feel; some of the softer kinds, indeed, give the idea of fluid. They are tumours of adult life, being rarely met with in children. They increase in size with variable rapidity, the amount of fluid they contain materially affecting this feature. The pendulous fibrocellular outgrowths, mucous or cutaneous, at times swell out and at others contract, while those of the skin appear shrivelled and loosely encapsuled. Those of the genital organs may attain a very large size, some which are on record having weighed as much as forty pounds. At times these tumours inflame, slough, or ulcerate in an indolent but in no way a typical manner.

Generally rare.

Always encapsuled.

Usually adults.

May undergo changes.

Myxomata are mostly soft, succulent tumours, made up of loose connective tissue, with more or less of their own special tenacious gelatinous secretion. They are not rare about the angle of the jaw, nose, breast, and abdomen. They are met with also in the extremities and in the eye, as well as in the delicate connective tissue of the nervous system, particularly of the brain and also of the nerves. When attacking the brain and nerves such growths are commonly found in the young; Virchow has named them *gliomata* (Fig. 30), the cells being of a small round or pointed form, embedded in granules and held together by delicate fibres. In some cases the fibre element approaches the firmer kind of fibrocellular tumours.

Myxoma. Characters.

Glioma.

TREATMENT.—Excision is the only practice that can be followed; although this operation need not be performed when the tumour is small and not progressing, especially when it occurs in aged

Treatment of the fibrocellular and myxomatous tumours.

people. Good success usually attends the practice. In the firmer fibrocellular varieties, and in the firm myxomata, a return of the tumour is not to be expected, but in the softer myxomata, where cell elements predominate, the risks of a return are great.

Fibrous tumours—Sarcoma. On fibrous tumours.

This term is applicable to the denser form of tumours or outgrowths made up of fibre tissue or closely-packed connective tissue elements (Fig. 29). When mixed with the non-striped muscular fibre, the growth is known as "*fibro-muscular*," or as a "*myoma*" (Virchow's term). Varieties. When associated with cysts, it is called "*fibro-cystic*," and when with calcareous matter "*fibro-calcareous*." These varieties are found chiefly in the uterus. Fibrous *outgrowths* or *polypi* are commonly met with in the uterus, pharynx, and occasionally in the rectum. They have been found in the intestine and other parts. Fibrous tumours are found likewise in the uterus and prostate, and *occasionally* in connection with the bones, periosteum, nerves, and skin. In those about the bones the elements of bone or cartilage are usually found. Fibrous outgrowths.

Fig. 20.



Fibrous tumour.
Drawing 387[92], Guy's Hosp. Mus

The fibrous outgrowths have no capsule, but are continuous with the tissue from which they spring, and are made up of fibre tissue more or less closely packed and arranged in bundles or in concentric circles; they are but feebly vascular. Those of the uterus are the most typical. (Fig. 20.) Fibrous outgrowths are not encapsuled.

Fibrous tumours are always encapsuled, and have a tendency to assume an ovoid or globular form when not confined, but when compressed or bound down by surrounding parts, they take an irregular lobular shape. In structure they are very similar to the outgrowths. Fibrous tumours are encapsuled.

Fibrous tumours are firm, and occasionally most unyielding. They are slow in their increase, and give pain only from their position. When bound down by a dense fascia or situated near a nerve they cause much distress. They only interfere with life or comfort mechanically. They are usually single, except in the uterus and when in connection with the nerves. As they come under the notice of the surgeon, those connected with the periosteum or bones, called *periosteal sarcoma*, are the most common, and of all bones the jaws are the most frequently affected by them. They are chiefly peri- Characters. Situation.

osteal and appear as outgrowths (*vide* Chapter on Tumours of Bone). They are found in the pharynx, on the lobule of the ear, and on the nerves as "neuromata."

Subcutaneous fibrous tumours.

The **subcutaneous fibrous tumour** is a hard movable tumour beneath the skin. It is usually small, but when of a less dense kind and more nearly approaching the fibro-cellular tumour, it may attain a large size. Under these circumstances the skin will become part of the tumour, it will then often ulcerate and allow the growth to protrude through the opening and ulcerate or even slough, and thus these tumours sometimes bleed freely. At times fibrous tumours seem to grow from the deep fascia.

Treatment of fibrous tumours.

Excision is the only treatment which offers any prospect of success, and when these fibrous tumours are removed a recurrence is rarely met with. The fibro-muscular, fibro-cystic, and fibro-calcareous tumours are mostly uterine.

Enchondroma.

Enchondromata, or cartilaginous tumours, are most commonly met with in connection with bone; next in frequency they are found in the parotid or submaxillary regions, and are seen in the testicles, intermuscular septa, and other parts.

Usually in young persons.

They appear, as a rule, in young subjects, in people under middle age, and are far more common, according to my own notes, in the female than in the male. They are usually slow in growth, the majority having existed years before the patient seeks advice. The instances of tumours of rapid growth on record are rare. These tumours, when

Are encysted.

not outgrowths, are always encysted, and have a smooth, tense, and elastic feel. In some examples they are uniform and even, in others bossy and nodulated; they rarely cause pain, and produce anxiety

Those in the parotid region.

simply from their position and size. Those in the parotid or submaxillary region appear to grow superficially, and to be movable; but they often dip down deeply into the tissues, and considerable care is required in their removal; as often as not they are very adherent to the surrounding parts. These simple parotid tumours rarely involve the facial nerve or cause paralysis, as do the cancerous tumours. When the cartilaginous tumours grow *within* bones they expand them into a thin shell.

Characters.

These cartilaginous tumours are usually innocent, and consequently only separate the parts between which they are developed. They never involve the integument by infiltration, but only stretch it; in exceptional instances they excite inflammation and ulceration in the skin, with subsequent perforation; they do not affect the system through the glands, although it must be added that rare examples are on record in which cartilaginous tumours have returned and affected the lymphatic system like a cancer. Sir J. Paget has

Fig. 21.



Section of an enchondromatous tumour expanding metacarpal bone.

recorded such an instance in the 'Med.-Chir. Trans.,' 1855, and De Morgan in the 'Path. Trans.,' vol. xx.

The section of a cartilaginous tumour is fairly characteristic (Fig. 21). It cuts crisply and presents a smooth surface; it may appear of one mass, or made up of many lobules. In some cases the consistence of the tumour is close, and is composed of translucent or bluish masses of fœtal cartilage, as is best seen in the periosteal forms. In others it is loose and granular, as in those expanding the bones. In many of them fibrous or glandular tissue is intimately mixed with the structure of the tumour, the parotid tumour affording the best type of this kind. In the cartilaginous tumours of bone, bone elements are always present; in those of periosteum, fibrous elements; and where glands are involved, glandular structure. When cartilaginous tumours soften down cysts are found, usually containing a dirty brown serous fluid, or simply filled with broken-down tissue and pus, or with a more tenacious synovial kind of fluid. Appearance on section.

Microscopically, cartilaginous tumours present diverse forms, simple fœtal cartilage-cells, embedded in some cases in a hyaline or in a granular matrix, in others in a fibrous or glandular stroma, or even both in different parts of the same growth. The most typical form is that in which the cartilage-cells are grouped together in masses, surrounded by fibre tissue. From this type great deviations occur, the cells being, more or less, scattered between the fibres. In some instances the nuclei of the cells are free and numerous, in others they are filled with granules or oil-globules, apparently degenerating. Occasionally, the cartilage-cells are developing, and take on the mature form of bone-cells (Fig. 28). Under the microscope.

Treatment.—The removal of the cartilaginous growth is the only efficient treatment, but the practice must be determined by the position of the growth and all the other points with which the tumour is clinically surrounded. When removed, a return rarely takes place. Cases, however, are on record (the Guy's Museum containing a few), in which a return ensued after a second or third excision, but such instances are exceptional. Treatment.

The cartilaginous tumours of bone will be considered under the head of Diseases of Bone.

Osseous tumours naturally come to be dealt with after the cartilaginous, for the two elements are usually combined; and, as in the enchondromata, traces of bone may be found, so in the osseous tumours traces of cartilage may exist. Osseous tumours.

These are found in two forms, the *cancellous bony* and the *compact bony tumour*, better known under the name of ivory exostosis. The latter growth is peculiar to the bones of the skull. Two forms. Ivory.

The cancellous is almost always developed through cartilage, and made up of tissue precisely similar to the cancellous tissue of bone. In some cases it is covered with a thin casing of compact bone, like the cartilaginous tumour growing within a bone, but in most it is covered with a layer of cartilage, by the ossification of which it grows. A diagram illustrating these points will be found in the chapter dealing with exostosis, and the clinical aspect of the subject will be again considered in the chapter on Tumours of Bone. Cancellous.

Myeloid tumours are, as primary growths, always found associated with bone, either growing from the bone, as in "epulis," or more com- Myeloid tumour.

monly in the bone, and when in this position usually in the articular end. The term was given to the class by Paget on account of the likeness between its cells and those of fœtal marrow. Lebert called them "fibro-plastic," and Virchow "giant-celled sarcoma."

Seat.

Characters.

When these tumours are periosteal they have the clinical features of a fibrous growth; when within the bone, they appear as chronic expansions of the articular extremity or shaft. When large and so expanded as to have burst through their osseous case, they appear cystic and semi-fluctuating—even to the extent of being pulsatile. They are usually slow in their progress, and often painless, and it is fair to suppose that many of the cases of cystic expansion of the articular extremity of a bone are due to myeloid disease. The disease is one of youth and young adult life; and the growth is usually single. It is not connected with any cachexia or glandular enlargement, as happens with cancer, and when removed it rarely returns. Instances of recurrence, however, have occurred, and I have seen one. Sir J. Paget has recorded others.

Appearance on section.

A myeloid tumour presents in section a peculiar appearance. It may be solid or cystic in variable degrees; osseous matter, fibrous matter, or fluid may exist in different proportions; yet in every specimen the cut surface will present blotches of a pomegranate crimson or of a darker blood colour, these tints mingling more or less regularly with those of the other tissues.

Microscopic characters.

Under the microscope the characteristic polynucleated cells are seen; these are large, round, or irregular cells containing many, even ten or more, oval, well-defined nucleated nuclei floating in a clear or granular substance. They are found in masses or distributed throughout the tumour between the bundles of fibre tissue. They are diagnostic of myeloid disease. With these cells Lebert's caudate or spindle-shaped cells are also found (*vide* Fig. 29).

On glandular or adenoid tumours.

Situation.

Glandular or adenoid tumours are new growths simulating more or less perfectly the gland structure in the neighbourhood of which they grow, and are not hypertrophies of the glands, but distinct tumours. In the breast the usual innocent tumour of the organ is of this nature, and is called *adenocele*, but it is also found in the prostate, uterus, lips, tonsil, thyroid and integument. They are not rare as lymphatic glandular tumours. Fig. 31 represents admirably the microscopical features of the adenomata as a class, and fig. 22 the appearance of such a tumour in section, some parts being solid and others composed of pendulous intracystic growths.

Characters.

Encapsuled.

They are generally growths of young life, and are found during the active period of a gland's existence. They are always encapsuled, and can usually be turned out of their bed with ease on dividing the capsule. They generally assume a rounded or ovoid shape, and are distinctly movable beneath the integument which is not involved.

Appearance on section.

"On section," says Paget, "they commonly appear lobed, or interseeted with partitions of connective tissue, and are pale, greyish or yellowish-white; in some specimens looking translucent and glistening, in others opaque; in nearly all acinous or glandular. To the touch, some, especially the white and more opaque, are firm, tenacious, and elastic; others, especially the yellow and more glistening, are softish, brittle, slippery, and succulent,

May contain cysts.

with fluid-like serum or synovia. Not rarely cysts are embedded in the solid growth, and these are filled with serous or other fluids like those which are found in the barren cysts of the mammary gland itself. In the

labial and parotid glandular tumours portions of cartilage or bone may be mixed with the glandular structure; and sometimes—chiefly in the mamma—the glandular tumours appear as if formed wholly or in part of clusters of small sessile or pendulous growths, which fill cysts May contain cartilage or bone.

Fig. 22.



Adenoma of the breast, illustrating the pathological appearances of adenoid tumours.

or partitioned spaces; thus they indicate their relation to the proliferous cysts, and suggest that they originated in such cysts. The textures around the tumour are usually quite healthy, altered only by displacement." These glandular tumours are often single, but at times multiple. Thus in the breast they may be many, and so loosely encapsuled as to move about as in a bag; in the lips they are commonly numerous; while lymphatic glandular tumours are almost always multiple. They grow with very variable rapidity, at times more slowly, at others with great rapidity. They require removal simply from the inconvenience caused by their mechanical pressure. Number. Growth.

To remove them it is only necessary to divide their capsule and the soft parts covering them in and to enucleate them. This need not, however, be done under all circumstances, for these glandular tumours not only cease to grow but at times disappear; thus operative interference should only be entertained when the growths are large or increasing, or very painful. Medicine does not appear to have any influence in checking their growth. Treatment.

The glandular tumours of special regions will receive notice in the different chapters devoted to their consideration.

Vascular and erectile tumours are considered in Chapter X.

Papillary growths, or tumours, require a brief notice. They are found in the outside or inside skin, and in the mucous membrane, while instances are on record where they were found on serous membranes. On the skin they occur as warts, cauliflower or sessile, and as condylomata. Some of the horny skin growths are of this nature. They occur in the mucous membranes as villous growths, and I have seen them on the hard and soft palate, tongue, rectum, and bladder. The two latter regions are indeed common seats of the affection. They seem to be a mere delicate outgrowth of subcutaneous or submucous tissue, with their natural epithelial covering, at times involving the gland structure of the part. They are usually innocent, though occasionally cancerous elements infiltrate the parts. Papillary tumours. Warts, &c.

Recurrent tumours. General remarks.

II. Recurrent or semi-malignant growths.

It will have been observed that in nearly every group of tumours which has been described, recurrence after removal has been alluded to as a possible, although a rare, event. In this recurrence, too, the new growths approach in character to the malignant. In some cases, doubtless, the second tumour has been simply the external manifestation of a small one which existed when the original tumour was removed, or the increased growth of a portion of diseased tissue that was left—for the surgeon is often unable to perceive small tumours in excising the larger, as his incision leaves them unexposed.

Liable to fallacy.

On two occasions, when removing a mammary glandular tumour, I have exposed a minute growth of a similar structure by the incision made through a portion of the healthy mammary gland to reach the principal growth. In both these cases had the small tumour been left a recurrence would have been recorded. In cases of recurrent fatty tumour, or of fibro-cellular tumour, it is highly probable that a small portion of the tissue was left. On one occasion, when I was enucleating a fibro-cellular tumour of several years' growth from beneath the fascia covering the scapula, I discovered two smaller growths which might have been overlooked and would certainly have grown. Nevertheless, it is a

Explanation of the recurrency.

clinical fact that tumours, which are usually looked upon as innocent, occasionally recur; and the more the cell elements predominate in a new growth, the greater its succulence, and the looser its structure, so much the more prone is it to return. Each tumour, also, as it recurs generally becomes less solid, more succulent, and more rapid in its growth. With each recurrence the cell elements increase in proportion, and in all ways; "later formed tumours assume more of the character

Recurrent fibroid of Paget.

of malignancy than the earlier." All these recurrent tumours, named by Paget "recurrent fibroid," being usually composed of elongated, oat-shaped, candate, nucleated cells, like the so-called "fibro-

Sarcoma of Virchow.

plastic" cells, which are found in granulation and embryonic connective tissue. Virchow calls them "sarcomata" (*vide* Fig. 29).

Characters of recurrent tumours.

It must be observed that these tumours, as a rule, attack the young and healthy. They grow from a fascia or aponeurosis, are of slow growth, particularly at first, and destroy life only after many years, and from local causes. They return either in the spot from which they originally sprang, or from its immediate neighbourhood. They simply affect the part mechanically, by separating and surrounding tissues, but never by infiltrating them. The skin is stretched over the tumour, but never involved in it; and if destroyed it is by ulceration from over-distension, while the absorbent glands are never secondarily involved, even in extreme conditions. Such tumours are to the hand more or less fibrous and lobulated, their fibrous feel being much influenced by their rapidity of growth. When cut into, they present a

Appearances on section and under the microscope.

more or less compact surface, a clear serous fluid infiltrating its meshes; while even the finest microscopical section will be found tough and tenacious, and incapable of being pressed into a diffluent mass. Under the microscope they present an excess of uncleated cells and nucleated fibres, these, again, showing their tendency towards the characters of the malignant growth.

Treatment.

The treatment of recurrent tumours need not differ from that of the innocent, for as long as the disease is local, there is a reasonable hope that it will at last cease to recur after removal. "Sir J. Paget has known

cases in which recurrence ceased for at least seven years after a fourth and a sixth operation; and after each operation the patient may expect to enjoy a period of comfort. Dr. Esmarch, of Kiel, stated to Sir J. Paget that he had seen cases of recurrent fibroid tumour cured, and not again returning, in patients who took large doses of iodide of potassium for several weeks. Generally, however, the prognosis of recurrent tumours must be unfavorable unless Dr. Esmarch's plan often proves curative. The ordinary course is that the tumours constantly recurring grow more rapidly, leave shorter intervals of health, protrude sooner, bleed and discharge ichor more freely, and affect deeper and deeper structures, till excision becomes too dangerous, and the patient dies exhausted." ('Holmes,' vol. i, ed. 2.)

Prognosis.

III. Cancerous tumours.

What is a cancerous tumour? Of what is it composed? and How can it be recognised? are questions which the student is constantly asking, and few are more difficult to answer with accuracy or precision.

On cancerous tumours.

Pathologically, a cancerous tumour is *not* composed of any definite or characteristic elements, such as at once stamp it as being a cancer. It does not contain any distinct cancer cells which mark its nature, as the cells, nuclei, and fibres, which enter into the formation of a cancer may all be traced in other and in innocent morbid growths. "But neither in tumours of innocent character, nor in natural tissue, do these elements combine in such variety as is common in a single cancer" (Moore). It does not appear, however, to be incorrect to assert, that the more the cell elements predominate in a growth, and the more they approach an epithelial type, the greater is the probability of its being malignant, and therefore cancerous; for the soft cancers, which are undoubtedly the most virulent, are made up almost entirely of cells and nuclei—only enough fibre tissue existing to bind and hold these cells together.

Pathological condition.

It has been already shown how the so-called innocent tumour approaches the malignant in some of its features; and it must have been observed that those which form the intermediate links between the innocent and malignant, structurally approach the latter, in having more of the cell elements in their composition. The fibro-nucleated and recurrent tumours exist as proofs of this.

Affinity of the recurrent and fibro-nucleated tumours.

But these points touch only the anatomy and not the symptoms of those growths; they do not assist the surgeon to ascertain before its removal whether the tumour be a cancer or not.

What, then, are the external and general symptoms by which this point can be determined? And here it must be premised that in making a diagnosis, the history and progress of the disease is at least as important as the physical characters of the tumour.

Symptoms.

If a tumour be found in a part, *infiltrating the tissues* with which it is in contact, there can be little if any doubt as to its being a cancer, for no innocent growth infiltrates tissues—it only separates them. This question of infiltration of a part, or the mere separation of it, is most important, and is, doubtless, one of the most valuable means we possess for the purpose of a correct diagnosis (Fig. 402).

Infiltration as evidence.

A cancerous tumour, however, does not always infiltrate a part, although an infiltrating tumour is almost always a cancerous one; for

Cancer may not always infiltrate.

it may appear as a distinct and isolated growth, being then, in surgical language, described as tuberous (Fig. 403). What, therefore, are the symptoms by which a tuberous cancer may be known? And first of all, has the tumour itself any peculiarities by which its nature may be recognised? Unfortunately, a negative answer must be given to this question, for although it may not be unfair to suspect the presence of a cancer when the tumour does not present any of the special appearances or symptoms which commonly characterise the innocent growths, it can only be a suspicion, as many innocent tumours are, often deficient in the special symptoms, which, when present, readily attest their true nature.

Has no special appearances or symptoms.

A subcutaneous tumour, unconnected with the integument, with an irregular bossy outline, and of a firm, fibrous feel, will, in all probability, be of a simple nature, for these are not the characters of a malignant tumour; but another with a smooth uniform external surface may be either a simple or malignant growth. If, however, any adhesion or drawing in of the integument to the surface of the growth can be detected, or any immobility of the tumour upon the parts beneath, the suspicion of its being a cancer may be entertained (Figs. 399, 400, and 401); for I have already alluded to the tendency which the malignant tumour possesses to involve the tissues in its neighbourhood, and have pronounced that this tendency does not belong to the innocent growths.

Tendency to involve neighbouring tissues.

I proceed further to direct attention to another symptom, which, if present, is most characteristic of cancer; and it is a secondary glandular, lymphatic enlargement. If this symptom appears, the probabilities of a tumour being cancerous become very strong, as innocent and non-malignant tumours are rarely, if ever, attended with enlarged lymphatic glands.

To produce enlargement of lymphatic glands.

A distinct and isolated tumour, therefore, which does not possess any of the special characters of a simple growth; which is attended with some evidence of secondary affection or infiltration of the parts; and with which an enlargement of the lymphatic glands in its neighbourhood exists, may safely be regarded as cancerous. It is, however, only in the early stages of the development of a tumour that a difficulty in diagnosis is usually felt, because, as a rule, in the long-standing and well-developed growth, the diagnosis is not difficult.

Presumptive evidence.

The soft and so-called medullary cancer is the form which is usually met with during young life. It generally makes its appearance suddenly, and often after the receipt of some blow or injury. It grows, too, very rapidly, presenting a surface which, as a rule, is smooth and uniform, or of a semi-solid and fluctuating feel, and with large full veins wandering across. It is recognised by its sudden appearance, rapid growth, and uniform surface, points very different from those which simple tumours present, innocent growths being generally slow in their development, and more marked in their outline. The cases of medullary or soft cancer run their course very rapidly, and destroy life within a very short period of their development.

Soft or medullary cancer.

Characters.

Hard cancers are the affections of middle age and adult life. They grow more rapidly than the innocent growths, often not requiring more than a few months to establish their true nature; they seldom put on the external appearances of a simple tumour, and never exist long without assuming features which are more specially characteristic of

Hard cancer. Characters.

cancer, the implication of neighbouring tissues and secondary glandular enlargements being the chief features.

A *cancerous tumour* has therefore these characteristics:—

Summary.

1. The peculiar power of infiltrating every tissue as it encroaches upon it.

2. It spreads to the lymphatic glands of the neighbourhood through the absorbents.

3. It affects the body generally through the vascular system, thus giving rise to secondary deposits, that is to say, to the development of similar growths in the viscera or remote parts, the lungs and liver being particularly prone to its attack.

4. It is liable to recur after removal.

Varieties of terms employed.

Cancerous tumours have been variously described by authors; the *hard*, as scirrhous or fibrous; the *soft*, as medullary; the *open, bleeding, soft* cancer, as "fungus hæmatodes; "the *black*, as melanotic; *skin* and allied cancers, as epithelial; and *bone* cancers, as osteoid.

All have, however, the four special peculiarities that have been already described as characterising the disease.

In these pages cancers will be treated of as scirrhous, medullary, melanotic, epithelial, and osteoid.

Scirrhous cancer.

Scirrhous cancer is the most common. It is the usual form found in the female breast, and is seen in the testicle, tonsil, skin, bone, eye, rectum, or any tissue. It is the hard or fibrous species denominated "carcinoma fibrosum." When attacking a tissue either by infiltration (the most usual method) or deposition, it gradually encroaches upon the tissue; and when this is soft it causes its contraction as in the breast. The disease spreads outward, and soon takes possession of neighbouring structures by infiltrating them. In this way it becomes gradually less movable, and at last fixed. No structures resist its influence; fat, skin, muscles, and bones becoming filled with cancerous elements as the disease progresses. It is said "to increase most on the side of the chief arterial supply, and in that towards which by lymphatics and veins its constituent fluids most easily filter." (Moore.)

Mode of progress.

No structures resist.

Glands involved.

Thus the lymphatic glands become enlarged, and these in their turn may press upon nerves, causing pain, or upon veins, producing œdema. But cancers have not the power of living like innocent tumours, but are apt to degenerate and die; and thus, after a time, a cancerous tumour may soften down in its centre and burst, or die as a whole and slough out, or its surface may ulcerate. But, whatever happens, the disease still spreads in the neighbouring parts; indeed, after the sloughing of a cancerous tumour, this spreading action in the bed from which it has been enucleated seems to be more rapid. Thus, the death of one part of a tumour is seen with the rapid increase of another part, and in this manner the disease goes on encroaching upon and infiltrating and destroying all tissues in their turn, causing death either by exhaustion, hæmorrhage, or some internal complication.

Sloughing of the tumour.

Ulceration.

Termination.

When skin is infiltrated.

In some instances of cancer, the integument over or about the tumour, before ulceration occurs, becomes infiltrated with small shot-like tubercles; such a tubercle in its early stage feels to the finger like a foreign body introduced into the cutis; and as this grows it appears as a distinct skin tubercle. No clinical symptom is more characteristic of cancer than the presence of these skin tubercles.

In other instances the whole integument becomes œdematous and

Brawny condition of skin.

brawny, in fact, infiltrated with cancerous elements, this state betokening the most rapid form of cancer. This brawny condition of integument commonly follows venous obstruction from glandular enlargement, but at times it takes place before any such complication.

Cancer may become atrophic.

In rarer cases the cancer withers, "atrophic cancer," the disease slowly progressing to a point and then disappearing by a gradual process. Thus, cancerous tubercles will appear and disappear; cancerous nodules will form and fall off by the contraction of their own fibres. In this way cancer may become cured, or so stationary as not to interfere with life. I have had a case under observation in which the disease existed for twenty-three years, and seemed still local. I have recorded another in which the disease lasted twelve years, appearing and crumbling away at times during that period almost to a perfect cure.

Variety in rapidity of growth.

Cancers display a very variable degree of growing or existing power; and there does not seem to be any condition of the patient or of the tumour which either favours or disfavours these properties.

Some have an apparent vigour of increase that is remarkable, whilst others show no such tendency. In many cases a tumour that has been quiescent for a long period will suddenly increase actively.

Cancerous ulceration.

The same thing may be said as regards the *cancerous ulcer*. In the atrophic form this may be merely a superficial loss of substance on the surface of the tumour which may be covered with a scab or present a glazed or a very slightly discharging surface. In other cases the ulcer will show an irregular surface with an elevated everted edge infiltrated with new tissue (Fig. 25).

When a cavity exists.

When a cavity exists, formed by the softening down of the centre of the tumour or the enucleation of dead tissue, the irregular outline of the cavity, the fœtid semipurulent sanious discharge, as well as the ragged and infiltrated edge of the wound are characteristic signs of its cancerous nature.

Cachexia.

In such cases a cachexia becomes visible, a pale, bloodless, haggard look of sorrow and suffering, brought on by pain, sleeplessness, and exhausting discharges.

Pain as a symptom.

Pain in the development of a cancer is a very variable symptom. In primary growths it is rarely severe, unless some nerve trunk be pressed upon, or the tumour is bound down by a tense fascia or is developed within a bone. Under all these circumstances the pain is constant, of an "aching or of a so-called rheumatic kind." In others, it is usually compared to an occasional dart of pain through the part.

As a sign of secondary deposits pain, however, is a valuable symptom; neuralgic pain following the course of a nerve being enough to excite fear of some deep-seated secondary growth. Than this, no more valuable or reliable clinical symptom exists

Section of scirrhous cancer.

The *section* of a scirrhous cancer is generally attended with a grating sensation, the parts cutting crisply; it presents a *concave surface*, and yields on scraping a milky juice. The tumour has no defined margin, the diseased and healthy tissues, as it were, dipping into each other. The surface of the cut portion may be vascular or bloodless, and has a bluish-grey or streaked yellow aspect, according to the amount of cell or fibre elements entering into its formation, or to its progress towards degeneration; the yellow spots being indicative of degeneration. Occasionally cysts or rather cavities containing serum, blood, or broken-down

tissues are found in the tumour, and, at others, creamy saponified masses of degenerated tissues.

The microscopical appearances of carcinomata are well shown in Fig. 32.

Medullary cancer, like the scirrhous, is either *infiltrating* or *tuberous*, and possesses, in a marked degree, all the cancerous peculiarities. It is, doubtless, only a form of cancer and not distinct from the scirrhous varieties; because both often coexist, and the growths which are secondary to the hardest primary cancer are generally the soft variety. Medullary cancer is, however, the special form that appears as a congenital tumour, and which attacks children and young adults, and may be called "the cancer of young life." These growths form very rapidly and run their course far more quickly than the harder kind. They increase so fast that they push away the tissues with which they are surrounded more like the innocent tumours which separate them; their capsules prevent that general infiltration of the parts which is observed in the infiltrating form. It is found, although rarely, in the breast, yet more frequently in the intercellular tissue, and about the periosteum and bones. It is the usual form attacking the eye, uterus, tonsil, testis, and ovary; the bones and cavities of the head and face appearing peculiarly liable to its inroads.

On medullary cancer. Rapid growth. Situation.

These soft cancers usually appear as deep-seated swellings, and when not bound down by fascia or connected with bone are rarely painful; but when so situated a gnawing pain or ache is a frequent concomitant. As they progress and become more visible, they may present either a nodular lobulated or a smooth and uniform aspect; but in either case the integument covering in the growth will be traversed by many very large and dilated veins; while in some instances the growth has a bluish congested aspect, as if filled with venous blood (Fig. 401). These tumours are often so vascular as to pulsate, and thus simulate an aneurism. Such a symptom, however, is mostly observed in those connected with bone.

Characters. External appearance. Vascularity.

To the touch the swelling feels soft and fluctuating, often giving the idea of fluid, and should the surgeon, to satisfy himself upon this point, puncture the tumour with an exploring needle, blood will freely escape and with it some creamy tissue, which, under the microscope, will be seen to be made up of cells and nuclei.

Soft fluctuating feel.

When these soft cancers have burst through their fascial envelopes they grow more rapidly, and when they have made their way through the skin they, as it were, pulp out, and project much as a hernia cerebri does after compound fracture of the skull. The soft succulent granulations and blood-infiltrated tissues that project suggested to Mr. Hay, of Leeds, the term "fungus hæmatodes." When a soft cancer is filled with blood it is known as a "hæmatoid variety."

When bursting through fascia. Fungus hæmatodes.

When this form of cancer springs from fibrous tissue, or periosteum, it is often separated into sections by bands of fibres; and, when it originates in bone, it may be similarly divided by thin plates or outgrowths of ossific matter; these plates or laminæ being sometimes distinctly separate, at others so closely packed together as to form something like a skeleton tumour (Fig. 23), the cancerous elements clothing the bony outgrowths or surrounding and covering them in. For diagnostic purposes the detection of these bony plates is of great value. Cancer may, however, attack bone in other ways (*vide* Chapter XXXII).

When originating in fibre tissue and bone.

When attacking the lymphatics.

In cancer of the lymphatic glands these tumours develope to a large size. In the neck, axilla, and abdomen they appear when fully formed as fixed semifluctuating growths with the ordinary characteristics already described; and at first may be as movable as any gland. When they appear in the parotid region they usually if not always produce paralysis of the facial nerve; a clinical symptom I think I may say never found in the ordinary innocent parotid tumour; so that when present, this symptom is of value. As a rule, however, this soft cancer surrounds nerves and vessels without materially pressing upon them; large vessels and nerves being often found passing completely through their substance.

Fig. 23.



Cancer of bone. (Prep. Guy's Mus.)

Appearance on section.

The section of a soft differs from that of a hard cancer, as the "infiltrating" differs from the "tuberous" (compare Figs. 402 and 403); and differs also very materially in itself at different times. It may be firm or nearly fluid; white and creamy, or red and blood-stained. It may be soft from inflammatory action or degenerating from natural decay.

Lobulated.

Under all circumstances, however, it will be divided into lobules; fibrous septa or fibrous envelopes separating these lobules from one another, as the fibrous capsule of the parent growth separated it from the other tissues.

Material composing these cancers

The material composing these cancers, says Paget, "is a peculiar, soft, close-textured substance, having very little toughness, easily crushed and spread out by compression with the fingers. It is very often truly brainlike, most like fœtal brain, or like adult brain partially decomposed and crushed. Many specimens are, however, much softer than brain, and many, though of nearly the consistence of brain, are unlike it, being grumous, pulpy, shreddy, or spongy, like a placenta with fine soft filaments. Very few have a distinct appearance of fibrous or other regular structure."

Yield juice on pressure.

These tumours when pressed or scraped yield abundant "cancer juice," and such juice is generally diffusible in water. No better rough test, says Paget, exists for the diagnosis of medullary cancers than this. The stroma of this cancer element is filamentous, and more or less condensed; it is also generally very vascular. The cell element always predominates, but the cells in no way differ in character from those found in the fibrous or scirrhous form. They are, however, less closely packed together, and seem to be suspended in the juices

of the growth or enclosed within its delicate connective tissue (Fig. 32).

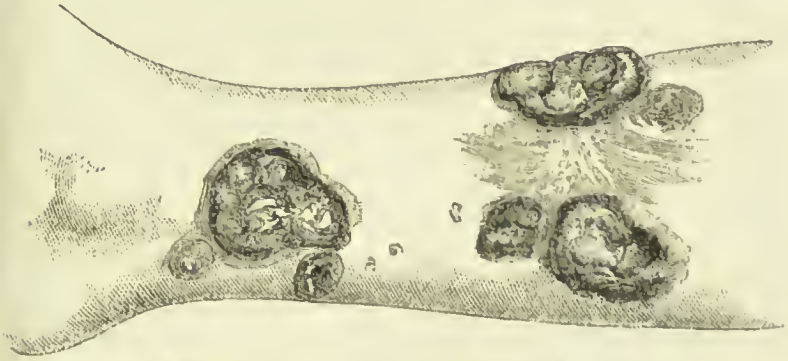
On melanotic cancers.

Melanoid or melanotic cancer is essentially a medullary cancer containing pigment, having its origin in a natural tissue, as in the choroid of the eye, or in a mole, in which pigment exists; but what it is that determines the development of these growths in tissues that have had a lifelong existence remains to be explained. The black cancers have, however, one peculiarity, and that is in their tendency to multiplicity. In this they are often most remarkable—the skin and subcutaneous tissues at times become studded with melanoid growths of all sizes and shades and colours. Fig. 24 is taken from a woman over whose

Situation.

Their peculiarity.

FIG. 24.



Melanotic cancer. (From Model, Guy's Mus.)

whole body melanotic cancerous tumours were distributed, the disease having originated in a mole which I had previously excised.

If it were necessary to adduce a forcible illustration of the fact that a cancer when first developed in a part partakes, in a measure, of the nature and peculiarities of that part, and even when repeating itself in the lymphatic glands and internal organs, still preserves the characters which it originally acquired from the seat of its primary development, no better could be adduced than that derived from the natural history of primary and secondary melanotic growths: for a melanotic cancer always grows from a part which naturally contains pigment, and a mole is unquestionably its commonest seat, while pigment in some of its forms is almost always to be met with in all its secondary growths. It may be, perhaps, that the secondary glandular enlargements in their rapidity of growth, outstrip the tumour from which they originally imbibed their peculiar nature; nevertheless, their true character is maintained and preserved to the end. This cancer, as a rule, is of the soft or medullary form, and runs a very rapid course; an extreme example of melanotic cancer, indeed, presenting all the worst features of the other varieties. In rare examples of this disease the melanotic pigment may be found in the urine. (Fagge, 'Path. Soc. Trans.,' 1876.) It has, however, peculiarities of its own, to which attention will be subsequently directed.

Pathology.

Situation.

The *osteoid cancers* will receive attention in the chapter devoted to the tumours of bone (Chapter XXXII). They are all probably only modifications of the medullary cancer affecting bone; although it may

Osteoid cancer.

be mentioned that exceptional cases are on record where an osteoid cancer originated in some intermuscular interspaces.

Epithelial cancer.

Epithelioma and epithelial cancer are terms given to a form of cutaneous cancer from its similarity in structure to the epithelial elements of the natural skin. In the chain of malignancy, epithelial cancers are linked to the recurrent tumours, for they have both a tendency to return in a part after their removal, and to affect the system through the lymphatics; while in exceptional instances they may be found in the internal organs.

Situation.

These tumours affect the skin or mucous membrane, and never originate in any other tissue. They possess this feature also in common with the more malignant cancers, in that they have a constant tendency to infiltrate the parts with which they come in contact, and do not, as innocent tumours, simply separate them. They are the common forms of cancer found in the lip, tongue, œsophagus, rectum, scrotum, penis, clitoris, os uteri, vulva, &c.; and may be described as the cancer of the skin, while in sweeps it is known as the "chimney sweep's cancer."

Sweeps' cancer.

Epithelial cancer is essentially an infiltrating disease; it is not, as the schaceous, fatty, fibro-cellular or fibrous tumour, a distinct growth developed in the tissues and separating them, but it is from its very beginning an *infiltration*. It begins, as a rule, in a wart or tubercle, which grows; it may fungate, crack, fissure, or ulcerate, and when this latter stage has been arrived at, its true character will at once be observed by the careful examiner, as the integument forming its base and margin will be evidently infiltrated with the cancerous material, presenting the well-known raised, indurated, and everted edges (Fig. 25). These appearances form a marked contrast to the condition of integument which in an innocent growth has been ulcerated or ruptured by over-distension.

Fig. 25.



Cancer of stump, of two years' standing, from a man, æt. 58.

As a local disease, this epithelioma may progress slowly for years and cause little pain, inconvenience, or injurious effects; five, six, eight, or even fifteen years having elapsed in some of the cases that have been under my notice before advice was again sought, and it may continue for many years before it affects a patient in other ways than by the local disease. On the other hand, when it once begins to spread, it may do so rapidly; after removal it may return at once, not only in the parts, but in the lymphatics of the district, and even in the internal organs. When it spreads locally, it may, as a cancer, infiltrate and invade every tissue which it reaches. I have seen it more than once originate in skin and end in a total destruction of a bone ('Guy's Hosp. Rep." 1875).

May spread rapidly.

Epithelial cancer: its characters.

Epithelial cancer is made up of cells, differing but little from those of ordinary epithelium, though they are grouped very differently, in-

filtrating the tissues in which they are placed or clustered together in masses, these masses being described as "nests."

The surface of an epithelial cancer may be dry and warty, or ulcerating; when ulcerating, it will be, like all cancerous sores, irregular, and will discharge a thin or a creamy fluid. The edge will always be thick and elevated, like a wall of new tissue built up between the healthy and diseased structures. When the disease spreads it will invade and infiltrate every tissue, forming deep excavated sores. It may involve the lymphatic glands like any other cancer, and these glands may soften down, and give rise to a cancerous abscess or an open sore. It usually destroys life from local causes, and not from secondary infiltration of the viscera, such a consequence being quite exceptional.

May involve glands.

These cancers should always be removed, and the sooner this is accomplished the better the prospects of a cure or of a long reprieve, for if any cancer has a local origin the epithelial has, and if it be removed before any glandular enlargement has taken place the prospects of a good result are great. Sibley ('Med.-Chir. Trans.,' vol. xlii) made out from the Middlesex Hospital records, that epithelial cancers, on the average, destroyed life in fifty-three months, while scirrhous lasted but thirty-two. When removed by the knife, care should be taken to cut well free of the disease, for it is not unusual in this, as in all cancers, to find the tissues around the tumour sparsely infiltrated with cancerous elements, which, if left, would cause a return of the tumour. The same advice is applicable when caustics are employed.

Treatment of epithelial cancer.

Removal by knife.

In many examples of this form of the disease the removal by the galvanic cautery is by far the best method of treatment we possess, either as a cautery applied to the surface, or as a wire écraseur applied around the base.

Removal by cautery.

Rodent Ulcers are closely allied to the cancers, and are more like the epithelial ulcer than the true carcinomatous form. Dr. J. C. Warren, of Boston, U.S., in an able essay upon this disease, asserts, that the cells of the rodent ulcer differ from those found in the epithelial by being smaller.

On rodent ulcers.

Characters.

FIG. 26.



Rodent cancer of the face, from an original drawing of Sir Charles Bell's, contained in the museum of the Middlesex Hospital, and recognised by Messrs. Shaw and Campbell de Morgan. It was introduced to my notice by my friend, Mr. Henry Morris, of the Middlesex Hospital, and kindly placed at my disposal by the Museum Committee of that Institution.

They are local cancerous affections, and

expend their force in destroying every tissue attacked, but they do not spread by means of the lymphatics or by secondary growths. They usually begin on some part of the face, head, or other locality as a dry wart, which, after it has shed many skins, begins to ulcerate. The ulcer then spreads slowly and regularly, with a border of new tissue raised as a wall, to separate it from the healthy parts; outside the border the parts are soft and natural, inside they are generally smooth, as an indolent sore, devoid of granulations, and glazed (Fig. 26). There is little discharge from these sores when superficial, but when they are extensive, and have dipped down deeply into other tissues, this is not the case; and

FIG. 27.



Case of colloid tumour of the breast, discharging externally, in a woman, æt. 65, with section of the same.

when they inflame, they discharge a fetid ichorous pus. They seem to attack healthy as well as feeble subjects, and have little effect upon the general health until they touch vital parts. They appear after middle age, and are to be treated locally, by their destruction—cautery, escharotics, or scalpel being used, as seems most applicable. In local sores the knife, when it can be used, is probably the best instrument; but in others the galvanic cautery is unrivalled. In lieu of this the actual cautery may be used, and next to this, escharotics; "the caustic burns through the entire depth of the solid disease, and upon the casting of the subsequent slough, cicatrization is rapidly completed."—*Moore.* Chloride of zinc, potassa fusa, Vienna paste, or acid nitrate of mercury may be applied; the zinc rubbed down in a warm mortar with equal parts of fresh plaster of Paris is probably the best, because it destroys and dries the tissues. Treatment of rodent ulcers.

Colloid cancer is hardly recognised as a special disease, for the term "colloid" is applied to tumours made up of intercellular spaces of variable sizes, filled with a clear glairy fluid like glue, which contains abundance of granules and large nucleated cells (Fig. 32). The clinical history of some of these growths is that of an innocent tumour, whilst in others it is that of a cancerous nature. Colloid tumours are found in the breast, parotid region, ovary, rectum, and intestinal canal. It being known in this last region as the alveolar or gelatiniform cancer. Their true nature is not yet fully understood. Colloid cancer.

In the case Fig. 27 the patient was 65 years of age, and the disease had been growing for two years. The tumour occupied the outer portion of the gland, and had burst the skin covering it in. The colloid growth projected through the opening, the margins of which, however, were not infiltrated with disease. There were no enlarged axillary glands.

Villous growths may be cancerous as well as benign. When made up of cell-elements their cancerous nature is to be suspected, but the fact is only to be discerned by the clinical career. The nature of villous and colloid disease has been very ably discussed by Mr. Sibley, in the 'Med.-Chir. Trans.,' vol. xxxix, and 'Path. Trans.,' vols. vii, viii, and ix. Villous growths.

The causes of cancer.

On causes of cancer.

These are most obscure. *Local injury* at times appears to have a very marked influence in determining the seat of a cancer, yet only in exceptional cases; one of such occurred to me recently in the case of a boy, æt. 18, who, after an injury to his right spermatic cord, in a few weeks became the subject of a pelvic tumour, which rapidly grew, and eventually destroyed life by obstructing the rectum as well as the ureters. After death the tumour was found to have been cancerous, having originated apparently in the right or injured cord, spreading downwards along the vas deferens to the base of the bladder, and subsequently ascending from the pelvis, above the level of the umbilicus. Local injury.

Hereditary influence has always been considered as a very decided cause, still in how small a proportion of cases can any such be found? Sir J. Paget traced it in one out of every three; Mr. Sibley in one out of every nine; and in 222 cases of my own, it was traceable only in one of every ten instances. In many other affections, even the most innocent, as large a proportion Hereditary influence.

might be found. In fatty tumours and in deformities, all surgeons recognise the frequency of an hereditary history. Indeed, looking at cancer as one of many diseases, there is no reason for regarding it as more hereditary than any other, and I am inclined to agree with Mr. De Morgan when he said "that all that could be said with regard to the constitutional nature of cancer applied equally to the constitutional nature of any, the smallest, growth that can be found in the body."

Striking examples of the hereditary nature of cancer are met with in practice, but they are not more striking, if so much so, as the hereditariness of growths of a simple kind. Sir J. Paget has pointed out, however, that when a local disease or deformity is inherited, it passes from progenitor to offspring in the same tissue, if not in exactly the same place, whereas, when a cancer is hereditary, it may break out anywhere. "The cancer of the breast in the parent is marked as cancer of the lip in the offspring. The cancer of the cheek in the parent becomes cancer of the bone in the child. There is in these cases absolutely no relation at all of place or texture."

A disease of adult life.

Cancer is a disease of adult life, although it may attack a fœtus in utero, or an infant soon after birth ('Guy's Hosp. Rep.,' 1875), but when it does affect an organ in the full vigour of its functional activity, it partakes of that activity and runs its course with marvellous rapidity. In a general way, however, cancer is most prone to attack an organ that has passed through the active period of its existence and is degenerating, as in the breast or uterus. Sir J. Paget describes it as being "essentially a disease of degeneracy," and asserts "that it increases in frequency in proportion to the number of persons living as age goes on."

Origin local.

Cancer appears to be in its origin a local disease and to become general either by the influence of the juices of the primary tumour exercising an impregnative, spermatic, influence (Simon) upon other parts, or by dissemination of its elements. This dissemination at first may radiate from its local source, and at a later period may become general through the fluids of the body; the secondary growths will partake largely of the characters of the primary, thus the osteoid cancer will propagate osteoid, and the melanotic melanosis, each cancerous growth, like a parasite, growing at the expense of the tissue in which it lies. Moore, in his work on 'The Antecedents of Cancer,' and De Morgan more recently have, I believe, established this fact. From a clinical point of view, this is, without doubt, of very practical significance, for surgeons now admit, that the earlier a cancerous tumour is removed, the better are the prospects of a cure, or, at least, of a long immunity from the disease.

Treatment of cancer.

Treatment of cancer.

The *general treatment* of cancer resolves itself into the improvement of the general health, the nutrition of the body by hygienic means, good nutritious diet, and tonic medicines. No medicine has any special influence on the disease.

Local measures.

The *local treatment* may be summed up in the word removal, for all cancers should, if practicable, be taken away as soon as their true nature has been established. In the early stage of a cancerous tumour, before the diagnosis has been made out, it should be protected from external injury, and from all irritating causes. No rough manipulation should be allowed, nor any movement of the

muscles that surround or influence it. Warm or hot applications should be avoided, since it appears they encourage its growth. The most acute cancer of the breast I ever saw was one that originated as a chronic infiltration, and was made active by the application of hot fig poultices for a week. The gland itself and skin over it to the limit of the application became infiltrated to an extreme degree with cancer, which rapidly broke down, and destroyed life. Avoid hot applications.

Moore used to think highly of the local application of the iodide of lead and opium ointment applied on lint to the tumour, and he believed it had some influence in diminishing and retarding its growth. Some have faith in iodine as a local application; but I must admit that I have never been able to discover that any of these or other applications had the slightest influence in checking the progress of a cancer, and have consequently discarded them. When pain is present, the belladonna-extract rubbed down with glycerine into a fluid the consistence of treacle, or of the extract of opium similarly diluted, seems to be a valuable application. An opium or belladonna plaster spread on leather gives comfort and protects the part. The best protective application, however, is cotton wool. Iodide of lead and opium. Belladonna.

When the diagnosis is established, the tumour should be removed, and the best method doubtless is, that of excision; delay being only justifiable when the general condition of the patient forbids the attempt. To delay is only to increase the risk of a local dissemination of the cancerous elements, and thus diminish the prospects of a successful result, giving time for the lymphatic glands to become enlarged, when removal of the primary growth becomes of less value; and to increase the chance of some internal or remote organs becoming involved, when operative interference is futile. Excision.

In removing a cancerous tumour the surgeon should not be too sparing of surrounding tissue; but when it is encapsuled there is no necessity for doing more than enucleating the mass. When it infiltrates an organ the only correct treatment is its removal, and in removing it care should be taken to cut away all skin that is in any way adherent to its surface, with as much of the surrounding fat as circumstances will allow. Free removal.

When the tumour has been removed, all surrounding parts should be carefully examined, because it is not uncommon to find small cancerous tubercles in the connective tissue, fascia, or muscular sheaths, which if passed by unheeded would soon increase and give rise to a recurrent growth. It is from these points, indeed, that such recurrent growths probably often arise, and these, by care and observation, the surgeon may often prevent. De Morgan, after excision of a cancerous tumour, washed the wound with a solution of chloride of zinc, twenty grains to an ounce, in order to destroy the cancer germs. The surgeon, too, had better remove all skin, and allow the wound to granulate up, than save integument which is of doubtful integrity for the sake of making an apparently more complete operation. When lymphatic glands are enlarged and can be removed at the time of operation, they should not be forgotten; and they should be enucleated by the fingers or handle of the scalpel rather than be excised—their capsules ought to be divided and the glands turned out. Avoid leaving tubercles behind. Glands to be removed.

Cancerous tumours of the tongue, penis, clitoris, labium, neck of the uterus, &c., may be removed by the wire or chain écraseur, either with

or without the cautery; but this part of the subject will receive attention in other pages.

Removed by caustics.

When a cancerous tumour cannot be excised or the cutting operation is rejected, it may be removed by caustics; but such a method is more painful, slower, and not so successful as excision. When employed as a substitute for it, it is, like all substitutes, only second best; yet it is, however, often applicable where excision is not. The French surgeons do this by inserting around and into the tumour, thin conical flat wedges of chloride of zinc made into a hard mass with flour or plaster of Paris, holes being made into the tissue by the scalpel for the introduction of these flèches. Maisonneuve is the chief practitioner of this school.

Caustic arrows.

These "caustic arrows" of M. Maisonneuve are composed of wedge-shaped pieces cut from a thin cake of paste made by mixing one part of the chloride of zinc and three parts of flour with as much water as may be found necessary. These pieces or arrows are dried, and may be kept in a bottle for a long time without injury.

In England this plan finds little favour. The following method is more general:—In a tumour that is not ulcerated let the skin be

Strong acids and caustic paste.

destroyed by the application of some strong sulphuric or nitric acid, and in this slough let one or more incisions be made; into which let a paste of chloride of zinc and flour mixed with the extracts of the Sanguinaria Canadensis, and stramonium, be introduced, fresh incisions being made through the thickness of the slough thus formed every other day, and fresh paste inserted. By this means the whole tumour may be destroyed or enucleated. The paste is a modification of that intro-

Fell's paste.

duced into London by Dr. Fell of the United States, and is, without doubt, the best working caustic paste we possess. The following is the mode of its preparation: Boil down to a liquid extract some decoction of the Sanguinaria Canadensis, and, with an ounce of the extract dissolve a similar quantity of the chloride of zinc. Mix this with two ounces of the extract of stramonium, and the soft paste is ready for use.

Canquoin's paste.

Canquoin's paste is composed of chloride of zinc and flour in equal parts, a few drops of water being necessary to make it into a paste. A second form is probably better:—Chloride of zinc one part, muriate of antimony one part, flour one part and a half, water a few drops. This paste is of the consistence of soft wax. At the Middlesex Hospital they use a paste made by mixing chloride of zinc and boiled starch with laudanum, till it reaches the consistence of honey.

When the tumour is ulcerating or open, no necessity exists for the primary application of a liquid caustic. The paste may be applied directly to the part, and fastened on by cotton wool and strapping; the thickness of half an inch applied for twelve hours usually produces a slough an inch deep.

Other caustic applications.

Some prefer a solution of chloride of zinc alone inserted on cotton wool. M. Rivallié uses nitric acid applied on lint or asbestos; Velpeau, sulphuric acid on saffron. By some, the Vienna paste is preferred. Arsenic as a caustic has had its day, and is dangerous and less effective than zinc.

Chloride of zinc paste in epithelial cancer.

For cutaneous epithelial cancer the caustic treatment is the best. The chloride of zinc made into a paste with flour, or with sanguinaria, may be used, if preferred. The potassa fusa is likewise a useful form.

When the galvanic, or thermo- eautery ean be obtained epithelial skin cancer may be readily destroyed. I bave burnt down many such affeeting the nose, cheek, eyelid, scalp, band, arm, lip, and otber parts. By it large surface of diseased tissne may be completely earbonised and a healthy surface prodnced after the removal of tbe eschar. The operation shonld be performed with the aid of chloroform, and the whole tbickness and edges of the diseased tissue destroyed. The after-pain is very slight, the cautery destroying all nerve sensibility. It is by far the best mode we possess of dealing with skin cancer, is more rapid in its action and certain in its resnlt, besides being far less painful. When the disease extends it may be removed with the scalpel and the base of the sore eauterized. No more efficient mode of removing a skin cancer is within our reach.

On treatment of tumours by injection.

Tbe treatment of tnmonrs by injeetion of fluids into their substance, as originally suggested by Sir J. Simpson, and more reeently practised by Dr. Broadbent, bas in it the elements of a successful plan, bnt bas not yet been brought to any available state of perfection. Fatty tumours may be destroyed by the introdnction into their snbstance of a few drops of deliquescent chloride of zinc, but cancerons tnmours do not appear amenable to a like remedy. Dr. Broadbent believes that he has succeeded by injecting a liquid composed of one part of acetie acid and three of water; while Messrs. Moore and De Morgan assert tbat they have each sneceeded by these means in obtaining gradual diminution of cancerous growths. I tried the plan in twenty cases, when it was first introdnced, but never fonnd any good result ensue. It was often very painful, and many patients refused to have it repeated, although they asked for the excision of the growth. More reeently the injection of twenty drops of a solntion of bromine dissolved in spirit, ɱv to a ʒj, has had its advocates.

The treatment by pressure is of no practical utility.

Treatment by pressure.

By way of summary, it may be stated (I) that caneerous tumours should be excised when practicable, and the sooner the operation is performed, after the diagnosis is clear, the better. That removal by the écrasenr is equivalent to excision.

Treatment of open cancer.

(II) Open eancerous tumours, as a rnle, should be treated by eanstics, the best being those which contain chloride of zinc or by enueleation.

Of skin cancers.

(III) For skin caneers caustics are, as a rule, the most available, although excision in some instances, as in tbe lip, is to be preferred. The galvanic cautery, however, should be employed when possible, it being tbe most rapid and efficient detsructive agent we possess.

THE MICROSCOPICAL ANATOMY OF TUMOURS.

By Dr. Moxon.

General observations.

Two distinct processes are observed in the constrnction of our bodies; the production of the elementary pieces, by whose compilation the fabric is composed; and the disposition of these elementary pieces into certain forms, whose shapes suit them to the reqnirements of the part to be made. These two processes differ as much as making bricks differs from building. Each of the tissues of which the body is eomposed has

constructive elements peculiar to itself, and these elements are disposed in each tissue in a manner proper to that tissue. I need not instance examples, the fact is so familiarly true throughout physiological histology.

In the composition of the normal tissues the elements are fitted in form, size, and other characters for their proper use, and they are united together to compose structures which are adapted to their peculiar functions. We have no knowledge of the influences which induce the perfect adaptation we thus observe; but we can appreciate its necessity, since, without such fitness of the parts for their several duties, organisation and organised life would not exist.

Now when *morbid* growths arise in the body, do they show any constructive plan parallel to that observed in normal tissues? Is there any constancy in their elements, any weaving of these elements into structures? It is only of late years that an attempt has been made to answer this very interesting question by careful study and comparison of the minute anatomy of morbid growths. It has been found that the nature of the elements of those growths, and still more the kinds of texture they compose, serve usefully to indicate the tendencies and consequent dangers which constitute their clinical importance as tumours.

Surgeons were formerly aware that in the healing of wounds the new materials are made in the likeness of the parts which they adjoin. But this assimilation of newly produced matter to the nature of the tissue adjoining was regarded, so far as it was regarded at all, as in some way the effect of the adjoining tissue. The production of new elements and their employment in construction of organised forms were not traced out as distinct histological processes; nor regarded as showing an active vital power in the new substance itself. And indeed we need to distinguish these processes more plainly even in our own time.

When the microscope was employed upon tumours as a means of discovery, observers at first looked only to the elements which coarse microscopical examination could easily discover; and for a long while it was, and with some still is, the only question, what is the character of the component cells of the tumour? As if in the study of buildings one considered only what sort of bricks or stones they are made of. True, this would serve to divide them into brick, stone, concrete, and mud buildings, and we must not despise such an advance, which is a real step forward, in comparison with entire ignorance of structural composition.

But now we no longer confine attention to the component cells of tumours; rather in the study of them we have a main regard to the mode in which they are put together, and the degree and kind of organisation which is undergone in the raising of them into often truly complex fabrics, such as we find many tumours to be when we properly comprehend their organization.

Construction of tumours.

It will naturally be asked, do the pathological tumours evidence any new plan of building, or are they always on the plan of some natural type; is there anything new in the nature, or, if I may so speak, in the conception of any pathological tumour? The answer which has the greatest authority, that of the illustrious Virchow, on its

side, is that there is nothing new in the plans of construction of tumours, but that all tumours are formed of substances natural to the body.

It has long been well known that a large proportion of tumours, especially those which show the most innocent disposition, have a structure like that of some healthy tissue. And this induced the naming of tumours after the tissue that they resemble, *fatty*, *fibrous*, *bony*, &c., or, as they are called, Lipoma, Fibroma, Osteoma (the termination -oma is now universally chosen to express tumour with structural resemblance to the tissue called by its prefix). Virchow's doctrine of the constant homology of every new tissue with some tissue natural to the body has induced him to carry this classification of tumours further than hitherto (unfortunately his book remains incomplete, and in some of the greatest difficulties the subject is still wanting his help). As a method of arranging tumours it is convenient; whatever may be said about his opinion, that no new substance can arise in the body. I believe that this opinion should be taken with due consideration if we would have a true view of the matter. Granting that whatever arises in the human body must be a human accident, so that feathers or cherry-stones will not develope in it, yet we must also see that the expression of all human accidents is not completed in the healthy man, but rather by elaboration and variation within him into something else, different, though still human. At any rate some intermediates between his healthy tissues might be expected. Many intermediates do positively arise which sufficiently show how wide a scope this possibility allows.

Indeed, it should be forcibly said that while those assumedly natural tissues found in tumours are really like the natural tissues of the healthy body in general description, yet they in all or almost all instances will be found to show differences in the building up of the elements, or even in the elements themselves, which make the common identification of them with the tissues they resemble rank only as a convenience, not expressing the whole truth of the matter.

So that I would lay down this proposition with confidence, that no morbid growth is ever found which has not in it sufficient peculiarity to distinguish it from all natural tissues, which peculiarity is to be looked at by those who would explain its characters and history; so that they should not exclusively regard those features it has in common with natural tissues. The practically important side of the matter is that osteoma is not bone, and enchondroma is not cartilage, and lipoma is scarcely fat. Nevertheless, it is very convenient to be able to classify tumours by their structural *likeness* to the natural tissues developed or in course of development. Yet it is only in this sense as *like, but not identical*, that the grouping of tumours to correspond with the grouping of natural tissues is here practised.

Malignant: Cancer.—The question must be dealt with, what relation does the histological structure of tumours bear to the common clinical division of tumours into *cancers* (*recurrent*) and *simple* tumours, or into *malignant*, *semi-malignant*, and *benignant* tumours? We will shortly consider these divisions. Simple or benignant tumours are those that have no malignancy, and recurrent or semi-malignant tumours are those which have only a partial malignancy, so that the

Malignancy.

only *positive* question is what characters make a tumour malignant or constitute it a cancer?

Malignant.—In a very common yet vague sense the term malignant is applied to any fatal tumour, superficial or internal. There is no defence for this except from colloquial convenience. Fatal tumours certainly are not easily viewed as benignant or innocent. And hence arises the common use of the word malignant for fatal tumours, making innocency positive, and regarding all that are not innocent as deserving by negation the opposite term. But as I have said, malignancy is the active and positive thing to which innocency stands as a negative.

General characters of malignant growths.

What are the active and positive characters and behaviour of a tumour that get it the name malignant?

A tumour obtains the name with different authorities from two rather distinct points of view.

First. Paget, for instance, has regard to the *descriptive peculiarities* of the more destructive kind of tumours, and hence describes malignant tumours as follows:

"1. The intimate structure of malignant tumours is, usually, not like that of any of the fully developed natural parts of the body, nor like that which is formed in a natural process of repair or degeneration.

"2. Malignant growths may have the character of infiltrations; *i. e.* their elementary structures may be inserted, infiltrated, or diffused in the interspaces and cavities of the tissues in which they lie.

"3. It is, also, generally characteristic of malignant tumours that they have a peculiar tendency to ulcerate, their ulceration being preceded by softening.

"4. The softening that often precedes the ulceration of malignant growths can hardly be considered separately from the minute account of their structure. I therefore pass it by, and proceed to their fourth distinctive character, which is to be noticed in the modes of their ulceration.

"5. Malignant tumours are, again, characterised by this: that they not only enlarge, but apparently multiply or propagate themselves, so that, after one has existed for some time, or has been extirpated, others like it grow, either in widening circles round its seat or in parts more remote.

"6. A sixth distinctive character of malignant tumours is that, in their multiplication, as well as in their progress of ulceration, there is scarcely a tissue or an organ which they may not invade."

Second. Other pathologists regard rather the *vital properties* of the tumours, which have been discovered as giving rise to those descriptive peculiarities which Paget enumerates; and hence say that a malignant tumour is one (1) which infects the neighbourhood, by dispersing its offsprung elements in the tissue around, so that it (2) recurs after removal, because its seed was left; and (3) also extends to the lymph-glands along the lymph stream, and (4) to the great vascular viscera, or to points in the whole blood-carrying system, by infection of the blood stream. In short, these pathologists reduce the word malignant into a compass which would be fairly expressed by such a bad compound word as auto-infectious.

Now, the compass of these two several lines of application of the word malignant is much the same. One describes what the other

explains; the other explains what the first describes. If we are to decide which is the better, it must be settled by observing whether description or explauation most nsefnlly determines the kind of a tumour. I think description must be widely and laboriously detailed to compass the expression of the signs of malignancy, and that the learner will scarcely carry descriptions which could fortify him against mistake. On the other hand, the conception of malignaney as anto-infeetiousness is at onee grasped, aud, if discreetly used, will generally serve to give a sufficient clue to the uatnre of any given tumour.

Thus, as to any tumonr of the breast, the inquiry, on one system, will be—"Does it push parts aside, or grow into them?" Ou the other —"Is the skin, &c., stretched over or involved iu the tumour?" These questions, you see, amount to the same thing.

Again, on the one system the question will be—"Does the disease infect all through to the surface, and then open on it?" On the other —"Is the skin simply stretched, perhaps burst throngh, aud does the tumour simply thrust ont itself, while healthy skin awaits its ehance to heal? Or, is the edge of the opening thiek and everted, and callous with such and such an ulceration?" This, again, is the same question. But, repeating, as the student can, such ways of considering the characters of innoceney, he will, I believe, soon learn to value the short comprehensive and comprehended grasp of them by the consequenees of their auto-infeetiousness, by means of which he can infer or explain the more tedious descriptive terms.

Cancer.—The word *cancer* is best regarded as the substantive which is equivalent to the adjective malignant, so that a tumour that is malignant is a eaneer, and a eaneer is a malignant tumour. If we accept this, there is no longer any need of discussing the compass of the word eaneer; and, indeed, now and always. this has been the most ready and natural use of the word, and the one most universally employed. For if you watch the writing or speaking of any one who, priding himself on deseriptive accuraey, limits the term caneer to carcinoma (p. 139), you will invariably find that before long he is using the word eancer as the equivalent of malignant. Cancer.

On the other hand, the word eaneer is made by some to be the equivalent of eareinoma; the latter having a limited application to a certain kind of tumour structure (see Fig. 32). Surely this is superfluous. The word carcinoma is enough for its proper application, and in pathological questions of preeision, there is no hurry or vagueness to preveut the employment of four syllables. So I think the word caneer may be left to its colloqnial wide signification as a malignant tumour of any sort, carcinomatous or otherwise. Certainly, tumours of various histological structure do prove auto-infeetious or malignant. The tumours which most frequeutly show this malignancy are in order—(1) Carcinoma in all its forms, (2) Sareoma, (3) Myxoma, (4) Lymphoma. Other tumours, also, are far from being free of the risk of auto-infection.

Recurrent or semi-malignant.—Auto-infection is, in some kinds of tumours, iueomplete in its manifestation. Thus, some spindle-cell sarcomas will recur often after removal, and yet show little tendency to invade the interual parts. Then, again, squamo-epithelial eancer extends to the glands, but not generally to the viseera. Also, soft, quickly growing sareomata will extend fiercely to the viseera, and not iuvade the glands at all. In other words, auto-infection, in its Recurrent growths.

three branches, viz. infection of site, of gland, and of viscera, is not seen equally in all the sorts of infectious tumours. This is significant, and needs working out. It is convenient to call imperfectly malignant tumours semi-malignant. Sir J. Paget proposed the term recurrent fibroid for spindle-cell sarcoma, and its use was at one time general, but is now giving way to the more systematic term. Some classification of the partially infectious tumours by their kinds of infectiousness may be agreed upon, but as yet the time has not come for it.

OSTEOMA, OSTEOID CHONDROMA, ENCHONDROMA.

Vide Fig. 28.

When bone forms a large part or apparently the whole of a tumour, the tumour is called an osteoma; but no tumour is ever formed altogether of bone, there is always present an ossifying matrix by the ossification of which the bony part of the growth enlarges. The kind of matrix varies much; thus, sarcomata or even carcinomata may directly ossify, and so we get *osteo-sarcoma* and *osteo-carcinoma;* but the kinds of matrix which produce growths of practically a bony nature are generally two, viz. periosteum and cartilage. Periosteum, or to speak more exactly a tissue resembling closely the deeper layer of the periosteum, forms large tumours whose transformation into bone takes place in the manner shown in the left side of Fig. 28; the cells take the shape of bone-cells, and the matrix calcifies; these tumours are called *osteoid chondroma* or *periosteoma.*

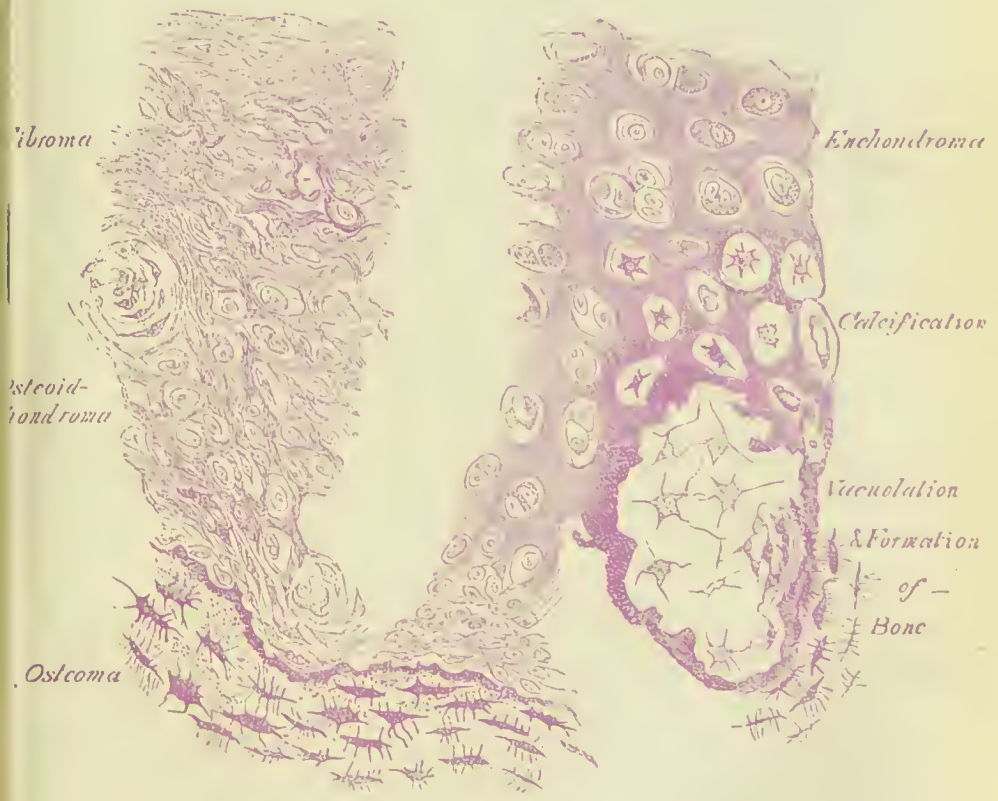
Cartilage often appears to be ossified when it is only petrified by deposit of calcareous salts in its matrix (see right side of Fig. 28); this change is, as is well known, the first step in ossification of cartilage. In many cartilage-tumours the process goes no further, or it may proceed to complete ossification through the several stages shown in the right side of the figure, viz. vacuolation, formation of medulla-cells in the vacuoles, and direct transformation of these to bone-cells, as seen in the lower and right part of the drawing. More rarely the cartilage-cells, without calcifying, proliferate and change directly into bone, as seen in the middle of the figure.

The amount of cartilage, periosteum, or bone, present varies indefinitely in different cases. When cartilage preponderates the tumour is called an *enchondroma;* when bone prepouderates, an *exostosis, osteoma,* &c., according to its shape and connections; when periosteum preponderates, an *osteoid chondroma,* as before said.

Occasionally the amount of bone and cartilage is so equal that it is a matter of difficulty to decide which name shall be used; and then the terms *cartilaginous exostosis* or *ossifying enchondroma* are employed. *Osteoid chondromata* are to be suspected of malignancy; such tumours compose a part of what were called *osteoid cancers.*

FIGURE 28.

MICROSCOPICAL ANATOMY OF OSTEOMA, OSTEOID CHONDROMA AND ENCHONDROMA.

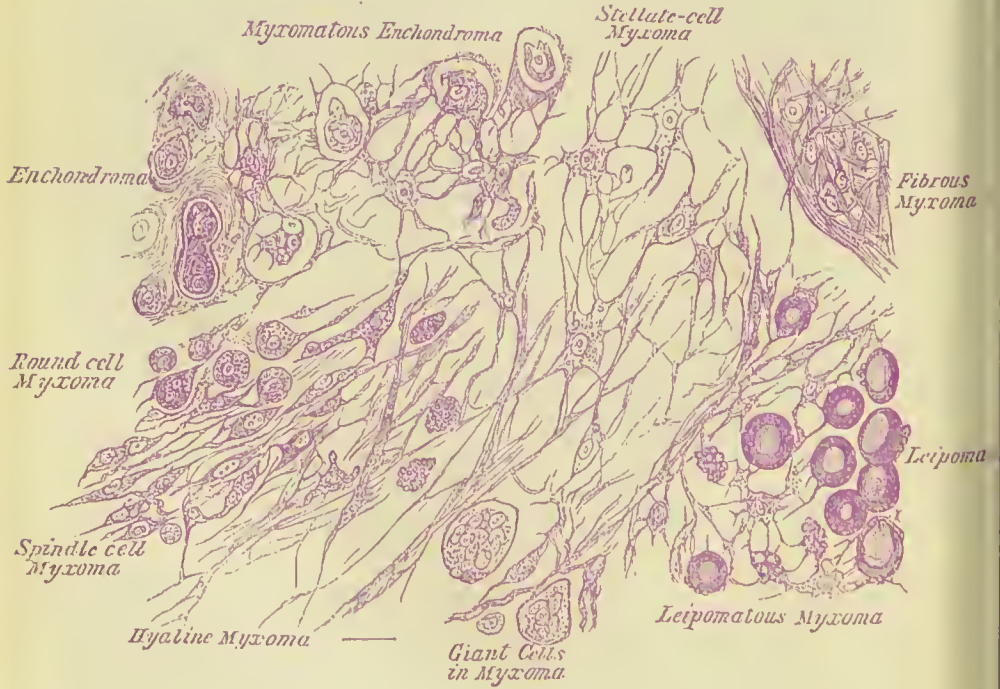


To face page 136.

FIGURE 29.—SARCOMA.



FIGURE 30.—MYXOMA.



SARCOMA.

Fig. 29.

The schematic figure (29) is composed of accurate drawings of portions of the several kinds of sarcoma named, but they are gathered together in a diagrammatic way, the forms being graduated into each other as they are when found side by side in the same tumour. You meet, indeed, with all gradations of intermediate forms; for although, as a general rule, one kind of sarcomatous tissue prevails in a tumour, it is far from unfrequent to have more than one of the kinds present together, the characters of each changing into those of the other.

The distinctive histological character of *sarcoma* is the possession of a stroma between the cells, an atmosphere of intermediate matter which surrounds each and is between them all; the qualities of this intermediate or "intercellular" matter determine the kind of sarcoma, as in the class of connective tissues whose developmental stages the several kinds of sarcoma closely resemble. The class of connective tissues includes the several kinds of texture whose office in the body is passively mechanical, either in serving as adjuncts to the muscular system or by filling up interstices between organs of the body or by entering into textures to support their component parts, blood-vessels, &c. Those connective tissues which penetrate into any of the organs of the body are modified in consistence and in arrangement of their elements according to the requirements of the organ. Thus, in the brain the connective tissue, called Neuroglia, is very delicate and soft, and has scarcely any distinctness. Also the connective tissue which enters into the lymphatic glands becomes reduced to very soft fibrillar matter between the lymph-cells. In these instances, and in others, the connective tissue thus comes to have peculiarities and to constitute strongly marked varieties. Yet all connective tissues possess this common feature in their elementary structural composition—that they are made up of cellular bodies between which their proper substance forms an intercellular matter.

The relation of sarcoma to the connective class of tissues appears to be this, that when one of these tissues is produced very rapidly it has no time for its intercellular matter to acquire the proper characters, and so remains indeterminate, while it also is small in quantity, the cells greatly preponderating. Thus, any of the normal connective tissues may produce by rapid development a tumour of sarcous tissues or sarcoma (the name is well chosen, σαρξ, which equals *caro* or our word *flesh*, means commonly any soft animal substance, not blood nor bone). Thus it follows that there are several kinds of sarcoma, according to the tissues from which they are developed. The principal of these are seen in the above schematic figure. The round-celled kinds generally arise from lymph-gland, or neuroglia, or mucous tissue; hence they are common in myxo- or glio- or lympho-sarcoma. The spindle-celled kinds arise from connective, fibrous, or bony tissue, and hence are most common in fibro-sarcoma or osteo-sarcoma.

MYXOMA.

Fig. 30.

The name myxoma is given to all tumours of connective-tissue type (not epithelial) which contain mucus or mucin in their intercellular

matter. It corresponds nearly to gelatinous sarcoma, collonema, and fibro-cellular tumour of old authors; the forms of the cells are very variable, but in the most typical examples, and especially in the older and fully developed parts, the cells are large and usually multipolar or "stellate," with a distinct nucleus and nucleolus; the stellate branching rays of the cells are mutually connected, so as to form a more or less open network, in the interstices of which the mucous semi-fluid lodges. Beams and bands, which generally have a stiff rigid appearance and an angular rather than a wavy disposition, pass about, dividing up the substance of the tumour into very imperfectly defined sections, more or less visible to the naked eye; from these arise fine fibrils continuous with the cellulo-fibrillar network. Much of the tumour, and especially the younger part, may be found formed of spindle-cells; these are really connected, by threads from their sides, with the intermediate fibrillar network, and it can often be seen that the stellate forms are produced by the drawing out of these threads to greater lengths, through the separation of the texture elements by the increasing quantity of mucus. In yet other examples or parts the prevailing form of the cells is round, or with one pole; the round cells resemble ordinary mucous corpuscles, and are scattered among the fibrils in the mucoid matter; they often contain many fat-grains, and are found in the oldest parts of the tumour, representing the senescence of its cells. There is also a great variability of the intercellular substance, first, in proportion of the fibrous to the cellular part; and second, in the proportion which these solid elements bear to the mucoid interstitial matter; thus, there is a fibrous myxoma, and a clear pellucid variety, with much mucous fluid, perhaps even forming cysts (hyaline and cystic myxoma). In some examples there are large polynucleated cells, identical with the so-called giant-cells of "giant-cell" sarcoma.

In the theory of types, myxoma is affiliated to certain natural tissues, in particular the jelly of the umbilical cord, the vitreous of the eye at a stage of its development, and the early stages of adipose tissue, or to a stage of bone formation out of cartilage. It will be seen that these typical tissues are only transitory in their nature, as compared with such stable tissues as bone, cartilage, tendon. In accordance with this instability of their type, myxomas themselves show many transitions to various kinds of connective tissue; these transitions are chiefly towards cartilage or fat (myxomatous enchondroma, myxomatous lipoma). Tumours are not infrequent, especially in the parotid region, which are intermediate between cartilage and mucous tissue, so that one cannot say to which they most properly belong; also, many fatty tumours show clear gelatinous patches of mucous tissue in all transitions to fat, while many myxomata show opaque spots composed of true adipose tissue.

ADENOMA.

Fig. 31.

The essential character of adenoma lies in the possession of a glandular structure; but the comparative amount of the glandular element varies much. There is also variety in the kind of tissue which is found between the gland-follicles. Some tumours show structure almost identical with that of compound racemose glands, having natural-looking

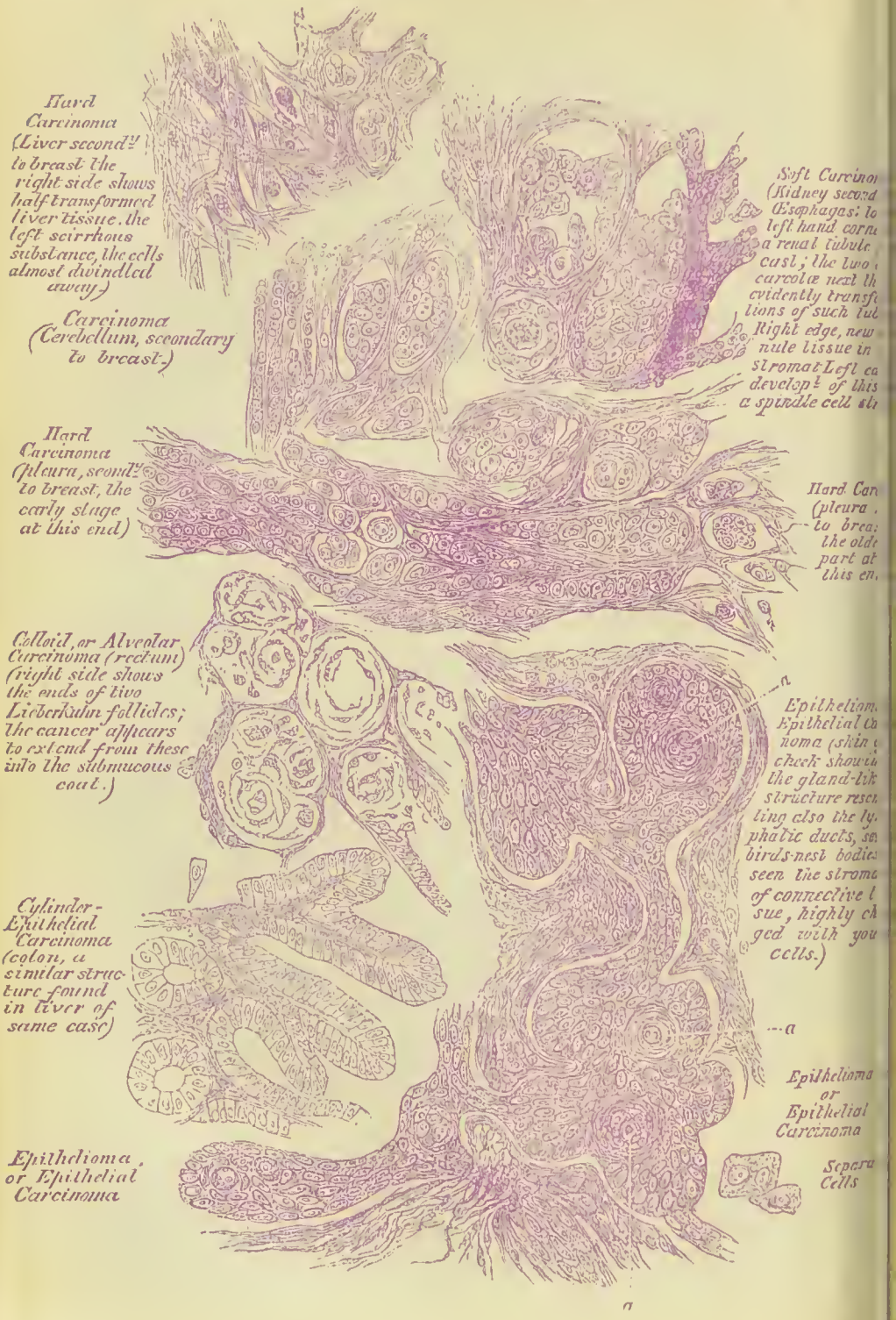
FIGURE 31.

MICROSCOPICAL ANATOMY OF ADENOMA.



To face page 138.

FIGURE 32.—MICROSCOPICAL ANATOMY OF CARCINOMA.



follicles separated by delicate connective tissue, more commonly the follicles are dilated more or less, so as to form cysts; one or more of these may prevail, so as to give a cystic character to the whole (cystic adenoma). Besides the cysts arising in this way, others may be formed by a breaking down of the intermediate tissue, especially if it happen to be mucous tissue. But as a rule the glandular elements are surrounded and separated by a more plentiful formation, which may be so much developed as to more or less entirely take away the glandular character of the growth; this interstitial tissue may either be fibrinous, sarcous, or mucous, or more rarely cartilaginous or areolar; or it may present characters combining these or mediate between them (*adeno-fibroma—sarcoma—myxoma*). When the proportion of gland is small, there is doubt whether it is not part of the original gland-tissue persisting in the new substance. Thus, the relative augmentation of the cavities of ducts or follicles may make the tumour take the character of cyst, or the relative augmentation of the intermediate tissue may make it take the character of sarcoma, myxoma, or fibroma; but if the glandular substance is maintained in due proportion, the natural resemblance of adenoma is to carcinoma.

And, indeed, if the glandular substance is maintained in due proportion, then a very little change is needed to give to adenoma the characters of carcinoma. When the characters of carcinoma are studied it will be found that these characters are of the same general description as those of adenoma. In either case there is a meshwork of fibrous or sarcous substance, forming spaces in which cells of a more or less epithelioid type are packed together. The difference is one sometimes requiring close observation and not always to be determined quite satisfactorily, whilst in other cases it is obvious enough. The structural difference between adenoma and carcinoma lies in this, that in an adenomatous tumour the glandular epithelium is regular and composed of even-sized and relatively small cells, whose nuclei are generally single and do not contain many nucleoli; the cells do not vary in form, and line the follicles of the adenoid texture in an even and orderly manner; whilst in carcinoma the nuclei in the cells are larger and brighter, and have many nuclei, and the cells vary much in form and size and compose usually compact masses projecting into irregular bulbs in the sarcous stroma, instead of lining follicular cavities.

CARCINOMA.

Fig. 32.

The term carcinoma is now distinctively applied to such tumours as have a structure of the following description, viz.—A meshwork of fibrous or sarcous substance composing an alveolar structure, whose interstices are filled with cells. These may have no orderly or methodical-looking arrangement, being packed in the crevices in the meshwork (or alveoli, as they are called), and extending casually from alveolus to alveolus, so as to make a complementary meshwork. The carcinomatous character is determined by the presence of such alveolar structure, with cell-collections lodged in it; the decisive point consists in these cells lying close together without any intercellular substance; the cells generally vary in shape, and have large nuclei, with large and bright nucleoli. But often the cells have an arrangement very like the epithelial lining of the follicles of the secreting glands, a structure

which may be so well pronounced as to bring them almost into continuity with adenomas; they differ from these chiefly in their history as being infectious, so as to extend into the neighbouring tissues, to the glands, or to the viscera. The structure showing only those minor peculiarities which I have just described.

Five leading types of carcinoma may at present be conveniently distinguished.

1st. Those in which the fibrous meshwork is in preponderance, and the epithelioid contents of the alveoli are scanty, and, perhaps, also prone to perish early, so that they are found more or less degenerate within the fibrous meshes—Hard Carcinoma, or Scirrhus.

2nd. Those in which the fibrous meshwork is in smaller proportion, and the epithelioid contents are plentiful, making large collections of cells, but with no evident approach in the form of these collections to the shapes of gland-acini, and no evident resemblance of the component cells, either to the columnar epithelium of mucous glands, or the squamous epithelium of cuticle—Soft Carcinoma. This kind occurs especially in glands, and the transformation of the glandular tubes or follicles to cancer alveoli can be seen in all stages in the growing margin of the tumour (see the upper two drawings in Fig. 32, from the liver and kidney).

3rd. A structure essentially such as that last described, but with this difference, that the epithelioid cells have a quantity of mucus between them, which is regarded as arising from a transformation of them. This change to mucus may be carried to such an extreme that scarcely any cellular elements are left, while the alveolar meshes in which the mucus is contained becomes very strikingly visible from its nakedness and the pellucidity of the mucus—Colloid, or Alveolar Cancer. A common seat of this is the wall of the alimentary canal, where it may be traced arising from Lieberkühn's follicles.

4th. A structure in which the epithelial cells resemble squamous epithelium, and form masses which are very like the follicles of cutaneous glands, or occasionally like rudimentary hairs; the tubular and bulbous forms may, however, be seen ramifying like the lymphatic vessels of the skin, as if their form were moulded to the lymphatic plexus—Epithelioma. In these cancers peculiar bodies are found, composed of flattened cells disposed concentrically so as to form a scaly-walled globe (*a*, Fig. 32) whose appearance is like the section of an onion, or like a bird's nest; these are so large as often to be visible to the naked eye; when they are numerous and well characterised, they are diagnostic; some authors (Billroth) distinguish a variety of this cancer in which the stroma preponderates over the epithelial part, calling it scirrhus of the skin—Squamous Epithelial Carcinoma.

5th. A structure in which the epithelial cells resemble ordinary columnar epithelium, and the structure itself is quite like normal mucous membrane, in which it always primarily arises (alimentary canal, especially colon, uterus); the secondary formations which occasionally occur in these cases, in the liver especially, have the same structure, and thus a tissue like the glandular mucous membrane of the colon may be found in the liver—Cylindrical Epithelial Carcinoma.

The fourth and fifth varieties are distinguished from the three first as epithelial cancers or epitheliomata. Some authors have used the term cancroid for the fourth variety, as though it were not completely

FIGURE 33.

MICROSCOPICAL ANATOMY OF LYMPHOMA.



To face page 141.

cancerous. These are less likely to infect the viscera than the first two varieties, which are the most infectious of all tumours, though they are very far from being the only kinds of infectious tumours.

LYMPHOMA.

Fig. 33.

The name lymphoma is given to such growths as have a microscopic structure like that of lymphatic glands; in particular, which have a finely reticular meshwork, connected with which are some fixed cells at tolerably regular intervals, not unlike the fixed cells of connective tissue, but generally larger. Within the meshes of this network are numerous cells, which resemble lymph-cells, and hence are also like pus-cells and white blood-cells. The proportion of network to the contained lymphoid cells is variable; sometimes the quantity of fibre is great, and the structure is then like lymph-gland tissue hardened by chronic inflammation. In other cases the proportion of cells becomes very large, while the network grows very delicate and open textured. The fixed stellate cells here appear to multiply, and produce a progeny of the loose movable cells in the meshwork, as if infected by the latter. The whole mass then appears as fine filaments making bold meshes, which are filled with round granular cells, like lymph-cells, but generally larger than these, and having large nucleus and many bright nucleoli. Such cells at first appear to make up the whole substance, but they easily brush or wash out of the meshes, leaving the network very conspicuous. It will be noticed that the degree of structure here described is very rudimentary. Indeed, sections of *ante-mortem* blood-clot from within a vein (see figure) closely correspond to the description. So also does tubercle in the more recently formed outer edge of it, where its texture is very like blood-clot; hence it is by some classed with lymphoma. Scarlatinous tonsils and typhoid Peyer's patches likewise have lymphoma structure. However, the plan of structure is so meagre that it is not enough to form a bond of union between diseases clinically so remote.

When found in the form of tumours, more properly so called, lymphoma generally takes its rise in the lymphatic glands; those of the neck are especially liable to it, then those of the abdomen and of the mediastinum. It is also found in the alimentary canal, especially the small intestine and stomach, and in the spleen, liver, kidney, &c. Formations of a similar structure have been met with in various organs in leukæmia, chiefly in the liver, in the form of small grains of a pale substance.

Lymphoma may prove malignant, that is, infectious to parts around, especially when the cellular elements are very numerous (in which case the tumour is called lympho-sarcoma by Virchow); it then corresponds to a part of what used to be included under the whole name medullary cancer, which, as formerly used, would include also soft sarcoma and soft carcinoma. Indeed, these tumours, when the cell-elements greatly preponderate, become very much like each other, if not undistinguishable as far as their mere structure is concerned.

Virchow, 'Die Krankhaften Geschwülste,' 1862-5.—*Paget*, 'Surgical Pathology,' 1870.—*Abernethy*. 'On Tumours.'—'Pathological Society Trans.'—*Wilks and Moxon*, 'Pathology.'—*Billroth*, Elémens de Pathologie Chirurgicale,' 1868.—*Holmes*, 'System of Surgery,' 1870.'—'Debate on Cancer of Pathological Society,' 1874.

SURGERY OF THE CUTANEOUS SYSTEM.

CHAPTER IV.

CONTUSIONS.

Contusion.

A "**contusion**" is caused by a blow from a blunt instrument, and is uncomplicated with any solution of continuity of the skin. When the blow has been sufficient to produce rupture of the small vessels in the skin and subcutaneous tissue, an "*ecchymosis*" or "*bruise*" is said to exist; when it so injures the deeper tissues as to cause effusion of blood from rupture of some of the larger vessels, "*extravasation of blood*" is said to be present.

Pain, swelling, and bruising are the three symptoms that consecutively follow a blow. In mild cases, however, the last need not necessarily follow.

Ecchymosis.

An "**ecchymosis**" is an effusion of blood *into* the skin and subcutaneous tissue, and it shows itself within a few minutes or hours of the injury, according to the force employed and depth of tissue injured, as a livid red, deep blue, or black patch, which in the course of twelve or eighteen hours becomes larger and lighter at its margins. About the third day it assumes a violet tint, on the fifth an olive brown, on the sixth a green, on the seventh or eighth it has a yellow aspect, and this fading into a lemon tint then disappears altogether. An ordinary bruise generally runs through all these stages in about two weeks, the rapidity of the process depending much upon the amount of blood effused and the reparative power of the patient. When no blood has been effused into the skin, but "extravasation" taken place in the deeper parts beneath a dense fascia, the discoloration of the integuments may not appear for three or four days, while in some cases where the blood has made its way between the tissues, and reached the skin away from the seat of injury, the "ecchymosis" will be at some distance from the spot at which the injury was received; and when much effused blood exists, the swelling will be great.

On making a section of a bruised part, the skin will be found throughout its thickness infiltrated with blood, and will feel firmer and thicker than natural. These points are sufficient to indicate the fact that the bruise had been received during life; for a blow applied to a body after death will never cause such general effusion of blood into the cutis, nor such an increase of firmness in the skin, while the effusion of blood that takes place will be in small quantities and venous, and beneath or upon, not in, the cutis,

Diagnosis from purpura, &c.

Neither *purpuric patches* nor those of "*erythema nodosum*" ought to be mistaken for bruises. The general diffusion of the spots over the body in the one case, and the history and general aspect of the other affection, should prevent the error. It should be remembered, however, that in purpuric patients and in "bleeders" a slight blow or pinch may be followed by a severe bruise.

A slight contusion may only be followed by some local pain and swelling, the swelling becoming red, and then disappearing. The

wheal that rises after a lash with a whip is the best illustration of this fact.

A severe contusion may cause a rupture of a large artery or veiu, under which circumstances a fatal extravasation may ensue; or, it may so crush or pulp the tissues as to destroy their vitality; which a spent cannon-ball may accomplish. More frequently, however, a severe contusion causes a separation of the skin from the deep fascia and parts beneath, with more or less extravasation of blood into the split tissues. The effects of a contusion also vary according to locality; thus, in an adult a blow over the scalp may be followed by a local effusion of blood, and in a child this effusion may go on so as to form a swelling involviug more or less of the whole vertex. In the buttocks and loins blood may be so effused as to give rise to a large fluctuating tumour. Iu the loose cellular tissue of the scrotum au effusiou of blood may give rise to enormous enlargement, and in the eye every one is familiar with the change. Where the extravasatiou of blood has been extensive, the removal of the clot is a work of time. Iu some cases the blood remains fluid for a long period, and at length becomes absorbed; in some it breaks down, and gives rise to suppuration. In exceptional iustances it becomes apparently encysted, and "there is sufficient reason to believe," says Paget, "that blood extravasated in a contusiou may be organised, requiriug the character of connective tissue, becomiug vascular, aud taking part in the repair of the injured tissues." These changes are seeu in the repair of fractures, and iu ligatured or twisted vessels. Iu some cases, in which a large blood tumour formed, and a solid coagulum existed, the clot suddenly softens down, and is then absorbed. In March, 1876, this was well illustrated in the case of a boy, æt. 12, who was under my care in Guy's Hospital, with an enormous blood tumour iu the gluteal region. Rupture of vessels after contusion.

Treatment.—A slight bruise requires no treatment, and if left alone will get well, for blood is often rapidly absorbed, as is seen in the eye. *To check extravasation*, cold is the best application in the form of pounded ice in a bag, or a mixture of salt and saltpetre, or the iced poultice.[1] Should any disposition to inflame appear, some lead or spirit lotion may be used. To hasten on the absorption of the effused blood, tonics are often of service, and the application of gentle pressure by means of bandages or strappings. Treatment of contusions.

A lotion of the tincture of arnica, one ounce to a pint of water, seems to have some influence in hastening the absorption of blood. Some of the stimulating liniments, such as the soap or opium, may likewise be employed.

In more severe and extensive effusion of blood, when the circulatiou in the part is interfered with, cotton wool or lint soaked in oil aud covered with cottou wool are the best dressings; by Local stimulants.

[1] *Ice poultices*, as suggested by Maissonenve, are excellent for the local application of cold, and are made as follows:—Take of linseed meal a sufficient quantity to form a layer from three quarters to an inch thick, spread a cloth of proper size; upon this at intervals of an inch or more, place lumps of ice of a convenient size—of a big marble—then sprinkle them over lightly with the meal, cover with another cloth, folding in the edges to prevent the escape of the mass, and apply the thick side to the surface of wound. The exclusion of air retards the melting of the ice and the thick layer intervening between it and the surface prevents painful or injurious contact. In injuries to the abdomen this remedy is very applicable. Dr. W. H. Doughty, of the U. S. A., speaks highly of it. Circular No. 8.

them warmth is maintained in the part; moist applications are not so good.

When the blood remains fluid, the surgeon must not be tempted to draw it off until all hope of its absorption has been abandoned. To meddle in these cases is often injurious; but when the blood has broken up and suppuration appeared, a free incision into the part, followed by the application of a poultice, is good practice, the cavity being kept clean by syringing with Condy's fluid or iodine lotion.

When incision necessary.

When the fluid blood has to be evacuated, it ought to be effected by a free opening, unless it can be drawn off by the "aspirator," or exhausting syringe, as by this means the fluid is removed and no air let in.

Wounds.

Wounds of soft parts. Varieties.

When the soft parts of the body are divided by any mechanical force applied externally, they are said to be wounded; when the "solution of continuity" is produced by a sharp-edged instrument, the wound is called "*incised;*" when with a pointed one that stabs or pricks, "*punctured;*" when with a blunt instrument that tears, "*lacerated;*" and when with any implement that bruises, "*contused.*"

When the parts are only divided, the wound is called "*simple;*" when associated with the introduction of foreign bodies, accompanied by hæmorrhage or pain, "*complicated.*"

All the above wounds are described as being "*open.*" (The outer part of the wound so gaping as to expose the deeper parts.) This term being applied in contradistinction to the "*subcutaneous,*" or that in which the external wound is very small in comparison with the internal.

Incised wounds.

Incised wounds, as made by accident or operation, *gape* much when the divided tissues are on the stretch, or the wound is transverse. In some localities this gaping is more marked than in others, the elasticity of the skin and possibly its muscularity influencing this result. Thus, in the sole of the foot and palm of the hand, the separation of the edges of a wound is very slight, when in the full mammary gland or in other parts of the body in which there is abundance of fatty tissue beneath the skin, the gaping is very great.

The skin is the most elastic tissue in the body, and retracts on division more than any other. Arteries, probably, are next, and muscles stand third, these facts being well exemplified in a flap amputation.

Hæmorrhage.

The "*bleeding*" that attends an incised wound depends entirely upon the size, number, and character of the vessels divided. In most people the division of *capillaries* stops by natural processes, except in subjects of the hæmorrhagic diathesis. *Venous* bleeding also, except from large trunks, usually soon ceases on elevating the part or on the application of a little steady pressure. *Arterial* hæmorrhage will be profuse when from large vessels, or persistent till the bleeding vessel has been secured by torsion or ligature.

The *pain* attending an incised wound varies in its nature and degree, according to the sensibility of the patient and position of the wound, the pain of anticipation doubtless aggravating it in the case of an operation.

Treatment of incised wounds.

TREATMENT.—*To arrest bleeding* is the surgeon's first aim, and in the chapter on hæmorrhage the necessary means will be discussed. To

clean the wound by the removal of all foreigu material is the next, whieh is to be done by the fingers and foreeps of the surgeon, and a stream of water over the part, aided by eotton wool, elean sponge, or tow. The less manipulation the surfaee of the wound is subjeeted to the better.

Where primary union is wanted, the eut surfaees and *edges of the wounds are to be brought into apposition* by means of sutures aud probably by strapping, and when the wound is a deep one these objeets are materially assisted by the lateral applieation of pads and the pressure of a bandage. Indeed, in the treatment of all large wouuds, whether the result of aeeideut or operation, in whieh primary union is desired, the benefit of a little firm pressure over the part is very advantageous; Value of loca
iu some eases a pad of lint is the best material to use, in others cotton pressure.
wool, while the whole should be bound together by some good strapping or a bandage. Where the edges of a wouud ean be brought together without sutures or strapping, a pad of dry lint fixed over the part by a bandage is an effieient dressing. Small aud superfieial wounds may be brought together by strapping, sutures being only employed when the length of wound is very extensive, or where there is too mueh gapiug, or, as on the faee, where strappiug eanuot be aeeurately applied.

In superfieial wounds the flexible eollodion of the British Pharmaeopœia may be used, the edges of the wound being held iu apposition whilst it sets. Two or three eoatings must be applied.

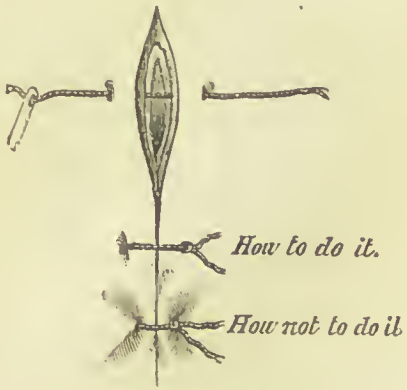
Iu wounds where sutures are not required, and the edges ean be brought together, lint saturated with the eompound tiueture of benzoiu is the best applieation.

Sutures in superfieial wounds may be inserted superfieially, but in deep On sutures.
wounds must be put in deeply. To adapt the skin surfaees of a deep wound without proeuring apposition in the deeper parts is bad praetiee, and, where union takes plaee, it produees harm, by holding in the seeretious. Sutures should only in exeeptional eases pass through museles.

Sutures.—There are four prineipal kiuds of sutures; the *interrupted, uninterrupted, twisted*, and *quilled*.

The interrupted suture is that usually employed in ordinary wounds. Interrupted
It ean be made with a eurved or straight needle, aeeording to con- suture.
veuienee, armed with a single thread of well-waxed silk—the fine silk line sold by taeklemakers being the best. The needle is then introdueed through one side of the wouud from without, inwards, obliquely through the tissues, and made to pass through the opposite side in the same direetion from withiu, outwards. The edges of the wound should then be earefully drawu together, and the two euds of the suture fastened in a double-reef knot. A granny (Fig. 120) is by no means a bad knot to make, as it is a slip knot, and may be tighteued at pleasure, a third kuot seeuring the whole. The knot of the suture

Fig. 84.



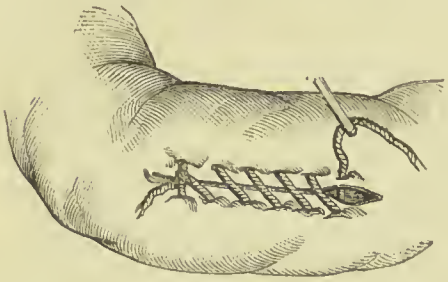
The interrupted suture.

too should be brought to one side of the wound (Fig. 34); and in fastening the suture it is only necessary to draw the knot tight enough to keep the edges of the wound in apposition, and not to strangle them, as illustrated in Fig. 34. In a large wound, sutures and strapping may alternate; in others the sutures may be inserted about half or three quarters of an inch apart.

Uninterrupted suture.

The uninterrupted, continuous, or Glover's suture is usually employed where a very close and accurate adaptation of the margins of the wound is wanted, as in wounds of the intestine, the eyelid, the face, and the penis after circumcision in the adult; also after the removal of the breast or other tumour. For this purpose the needle should be small and the ligature fine; and the stitch is that of the sempstress. Fig. 35 illustrates the suture as applied to the intestine.

Fig. 35.



The continued suture as applied to the intestine.

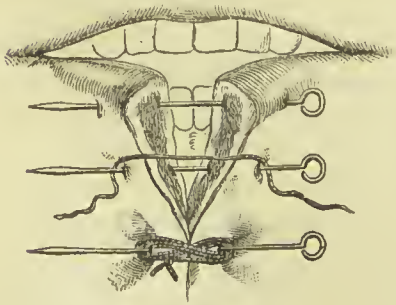
In both these forms of suture the stitches should be removed on the third or fourth day; they may often be taken out from the face on the second. If left in long they set up irritation and ulceration.

Iron, or silver wire sutures are preferred by some, as they are thought to be less irritating than silk. I have tested them together in the same wound on many occasions, and have failed to confirm this assertion. They are not, however, more irritating, and may be used; nor need they be tied, a double twist being sufficient to secure their ends. Wire sutures at times, however, set up very little irritation. Gut and horsehair seem to be the least irritating materials we possess for sutures, and should be used in plastic operations.

Twisted suture.

The twisted suture is that which formerly was always employed for bringing together the parts after the operation for harelip. It is still often so used, as well as in cheiloplastic operations and others on the face and abdominal walls. To apply it, some fine pins with flat heads, silk, and cutting pliers are wanted.

Fig. 36.



The twisted suture.

The pins are employed to bring the *surfaces* of the wound in contact. In lip cases, the point should be introduced half an inch or more from the margin of the wound, and passed obliquely through its thickness down to, but not through, the lining mucous membrane (Fig. 36.), then it should be introduced into the opposite side and brought out through the skin at a corresponding point. With a piece of silk the wound may then be drawn together

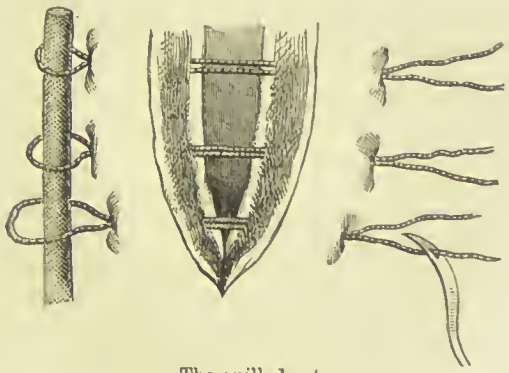
by means of a figure-of-eight twist around the two ends. Should the apposition of the surfaces be imperfect, the pin should be taken out and readjusted, and in this lies the great advantage of this form of suture. A second and third pin may then be introduced in the same way. After the silk has been tied in knots and the ends cut off, the points of the needles ought to be removed, and the soft parts protected, if necessary, from the ends by a small piece of lint or strapping passed beneath.

Instead of silk being twisted round the pins, a section of an india-rubber tube, in the form of a ring, has been employed by Mr. Gariel much in the same way as Mr. H. Lee applies his india rubber over a pin employed for varicose veins, either of the extremities or testicle. I have tried the plan in many cases, and find it, though beneficial, yet not better than silk.

The quilled suture is very valuable, particularly in deep wounds, tending more than any other to keep the parts in apposition. In plastic operations in the perinæum in the female it has always been a favourite, and although I gave it up in these cases for many years in favour of metal sutures, I now use it with considerable success. In gastrostomy it is probably the best we possess for holding equably the margins of the open stomach to the edges of the wound, as it is in other cases of abdominal cysts, ovarian and otherwise, in which the same end is sought. Quilled suture.

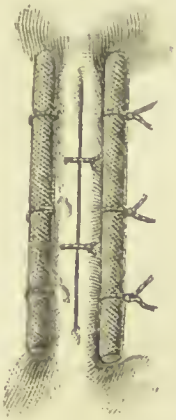
For the application of this suture, a strong curved needle with an eye at the end and threaded is to be inserted at least three quarters of an inch from one margin of the wound, and made to pass well down to its depths, then brought out through the other margin in a corresponding line. The loop of the suture should now be caught and held, and the needle withdrawn; a piece of bougie, cut the required length, being introduced into the loop, is fixed by drawing the free ends of the ligature home (Fig. 37). A second or third suture can be applied

Fig. 37.



The quilled suture.

Fig. 38.



in the same way. A second piece of bougie ought then to be tied on the opposite margin of the wound, the parts having been well cleansed previously, and carefully adjusted. The surfaces of the

wonnd are only to be held closely in apposition, and must not be pressed too firmly, otherwise the bongies will set up ulceration. Superficial sutures may subsequently be introduced into the edges of the wound (Fig. 38).

For the quill suture good fishing gut is better than silk or wire, it being strong, and unirritating. Before use it should be soaked in water to make it limp; it can be readily tied or fastened with a shot. The loops of the quill suture should generally be divided on the fifth or sixth day, this point depending on the amount of irritation caused by the bongie.

After-treatment of wounds.

When the edges of an incised wound have been brought together and well adjusted by sutures, they rarely require more protection than that afforded by a piece of dry or oiled lint. Wounds of the face may be left exposed. Dr. Krönlein, of Zürich, indeed, advocates the open treatment of *all* wounds.

In wounds of moderate dimensions, on the third or fourth day when union may be expected to have taken place, the dressings and sutures should be removed, and, when the repair is good, the parts may be left open.

In gaping wounds. Should there be any gaping of the wound or disposition to gape, the surgeon should apply strips of plaster across its edges as he removes the sutures, thereby giving support to the parts and guarding against their reopening.

When the union between the edges of the wound is poor, and the parts have to heal by granulation, water dressing should be applied.

In deep wounds. In large or deep wounds, where pads and pressure have been primarily applied, it is better to leave the dressings untouched for five or six days, and then only to remove them when evidence exists of the presence of some retained or irritating secretions, since it is better at times even to allow sutures to cut out their way than to disturb a wound in which quick repair is wanted and anticipated. When doubt exists as to the retention of fluids, some of the dressings should be taken away to allow of their escape, for pent-up secretions are most injurious.

Indeed, to sum up in three words the essentials in the after-treatment of wounds—*non-interference, rest,* and *cleanliness*—include everything, for—

Non-interference. By *non-interference* is meant, after the careful adjustment of a wound, and the close observance of the points that have been already alluded to in the primary treatment of wounds, the exclusion of all such curiosity as shows itself in too frequent dressing and examination, too early removal of sutures and the forgetfulness to support the edges of a wound on their withdrawal, in the application of dressings that may irritate directly or indirectly, and last, but not least, in all roughness in dressing.

Rest. By *rest* is meant the preservation of the injured part by means of bandages, and other surgical appliances, in the most favorable position for the natural evolution of the reparative process; and the observance of due care that no external influence is brought to bear upon the wound so as to interfere with or interrupt it.

By *cleanliness* is meant not only the absolute cleauliuesss of all instruments, dressing apparatus, and dressers' fingers, the removal of all putrefying or putrefiable materials from the surface of a wound or its neighbourhood, but the forethought which provides against the collection in as well as for the thorough evacuation from a wound of all pent-up fluid (whether blood, serum, or inflammatory products), by means of drainage openings or drainage tubes; and the care which sees that the air which surrounds the wound is not the vehicle of such infectious elements as may start erysipelas or septicæmic disease. The surgeon ought to know that wounds are as sensitive to outside impressions as are puerperal women, and that, in the one case as in the other, as much precaution is necessary to ward off external pernicious influences. Cleanliness. Drainage.

This latter part of the above principle of practice, however, is carried out in many ways; by such surgeons as Langenbeck of Berlin, Krönlein of Zurich, and Humphry of Cambridge, by the free exposure of the wound to a bath of fresh air; by Professor Lister and his followers by the exclusion of air that has not been rendered free from all *germs* of pollution by the unremitting use of what is regarded by them as the great germicide, carbolic acid, the wound upon this theory being so dressed as to ensure absence of putrefaction."

For my own part, I am no convert to either of these extreme practices or theories, and whilst claiming to be an antiseptic surgeon as much as others, believe that in non-interference, rest, free drainage, and cleanliness, the surgeon can get all he wants.

Punctured wounds.—When these are made with *sharp* and *clean* instruments and do not involve any important or diseased structures, they generally do well. When small, they do as well as the incised; and when large, are not so prone to unite by primary union. On punctured wounds.

When made, however, with *blunt* pointed, *rough*, or *dirty* instruments wounds never heal kindly, for the parts are *bruised* and *torn*, as well as separated, by the perforating instrument, and close again as soon as the instrument is withdrawn, thus there is retention of blood, and at a later stage of broken-down tissues, and should these decompose or mechanically irritate by their presence, inflammation appears with its local and constitutional symptoms. Should important parts be thus injured or the tissues be unhealthy, these results will be worse, and very serious consequences may then be expected.

When tense fasciæ, such as is found in the palm of the hand, sole of the foot, and scalp; or, when deep muscles, bound down by fascia, as in the thigh, are punctured, and such results ensue, the consequences are severe.

It is probable that it is the *bruising and tearing of the tissues* that make these punctured wounds worse than the incised; bruised and torn tissues rarely healing by primary union.

Treatment.—All punctured wounds, great or small, are to be treated with more caution than the incised. The parts should be kept at complete rest and elevated, a pad being carefully adjusted over the wound and evenly adjusted pressure applied to the parts. When all proceeds favorably, and repair ensues, the dressings may be left for four or five Treatment of punctured wounds.

days, and afterwards removed, the parts still being kept at rest for another week.

Should pain or swelling follow this primary dressing, the dressings should be at once removed, and warm-water applications or a poultice applied. When there is any evidence of retained fluid in the part, the external wound must be opened, the extent of reopening depending upon the amount of tension of the part. When suppuration has taken place, a free vent for the discharge must be maintained. Pain must be relieved by opium, and the general powers maintained by tonics and carefully regulated stimulants.

Arrow wounds.

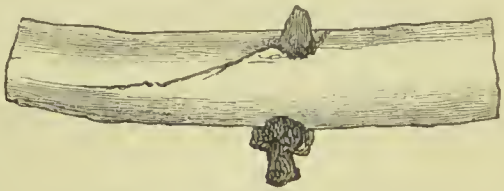
Arrow wounds.

These have been made the subject of a special essay by Dr. Bill in the 'American Journal of Med. Science,' vol. xliv. He tells us that it is exceptional to meet with single wounds, the American Indians discharging their arrows so rapidly that if one takes effect it is immediately followed by others. The Washington Army Medical Museum contains specimens of penetrating arrow-wounds of the skull. Where both tables are punctured there is little or no fissuring externally or internally, as the vitreous table is penetrated as cleanly as the outer. "This is in such marked contrast to the results of bayonet or sword thrusts or of the impact of gunshot projectiles as to merit notice."

Arrow wounds of the chest are not always fatal; those of the abdomen are generally so. Dr. Bill tells us that the Indians on this account always aim at the umbilicus, and that the Mexicans when fighting the Indians on this account always envelope the abdomen.

The velocity of the arrow when first projected is so great that it has been estimated to equal nearly that of a musket ball. At a short distance an arrow will perforate the larger bones without comminuting them, or it will cause a slight fissure only, resembling in these respects

Fig. 39.



Piece of buffalo rib pierced by arrow.
Surgeon-General's Office, U. S. Circ. 3.

the effect of a pistol ball fired through a pane of glass a few yards off. This is well seen in the drawing (Fig. 39), copied from a preparation of the section of the eleventh right rib of a buffalo fissured by an arrow, in the Washington Army Med. Mus., presented by Prof. Joseph Henry and copied from Circular No. 3.

The treatment of punctured vessels and cavities will be found in the chapters respectively devoted to those subjects.

Contused and lacerated wounds.

Contused and lacerated wounds never heal by primary or immediate union. The injured parts are so bruised and separated that some por-

tions of their surfaces are sure to die, hence healing by granulation is to be expected. They do not bleed as do the incised.

Nevertheless, they are to be treated with care, and as if they are sure to unite partially if not wholly. After their surfaces have been cleansed and freed from blood and dirt their edges may in many cases be brought together, sometimes by sutures, in others by strapping, care being always taken that the whole of the wound is not covered in, and that a free orifice is left for discharge. The surface of the wound may be covered with oiled or wet lint, and the parts should be well raised and kept at rest.

In skin lacerations of the extremities it is surprising at times to find how well the parts heal under this treatment, and how large portions of integument that have been torn off, when carefully re-adjusted, unite and maintain their vitality. When the parts are so injured that a fear of sloughing from want of arterial supply is felt, the whole should be wrapped up in cotton wool.

Water or oil dressing with or without opium, carbolic acid, or other drug, may be applied after the primary dressing has been removed, according to the requirements of the case.

Subcutaneous wounds are interesting subjects of study, inasmuch as surgeons are now familiar with the fact that tendons, muscles, and even bones may be freely divided with a very small cutaneous wound, and good repair follow, without any signs of inflammation, suppuration, or constitutional disturbance. When a tissue is divided, and its two divided surfaces are left in contact, they will unite as any other wound; yet when separated, the space between them will be filled in with new material that will organise and assume in time the characters of the divided tissue; at least, such changes occur in tendons. Subcutaneous wounds.

These facts render the subject one of great interest, and should cause the surgeon to look out for opportunities of applying the practice to more extended classes of cases.

The treatment of subcutaneous wounds resolves itself into closing the wound with a pad leaving the parts alone, and allowing them to heal, the quiet way in which this takes place contrasting most favorably with the repair of open wounds. The non-admission of air (not of "germs") being, probably, an explanation of the difference.

This subject will be more fully considered in the chapter on The Surgery of Tendons.

BURNS AND SCALDS.

A burn is caused by the application of concentrated dry heat to the body; a scald, by the application of hot or boiling liquid. As a rule, scalds are less severe accidents than burns, because water being the ordinary fluid through which the scald is produced, is never hotter than 212° Fahrenheit; yet when any other chemical compound is the scalding medium, the effects are, at least, often as bad as the worst burns. The worst local burn I ever saw was when a man put his booted foot and ankle into a pot of molten lead. The limb came out covered with a boot of metal, and was destroyed even to the bones. Mr. Aston Key amputated the limb at once below the knee, without removing the metal. On burns and scalds.

A moderate degree of dry heat applied in the pursuit of a calling indurates the skin and blunts its sensibility; and an ironworker or a

blacksmith can manipulate pieces of hot iron that would "burn" ordinary people. Thus, some skins or parts of the body are more sensitive than others, and, under the same influence, may be differently affected.

Varied effects of heat on body.

The effect of heat when applied to the body, varies according to its *intensity* and the duration of its application; it may cause a simple redness of the surface or the death of the part. Thus, its *first* morbid effect is mere *redness* and tenderness of the surface, and after a few hours, these symptoms may subside, the cuticle possibly desquamating.

First degree.

Second degree.

In the *second degree* of heat inflammation is the result, this action manifesting its presence by the formation of a *blister*, from the effusion of serum beneath the cuticle.

Third degree.

In the *third degree* the superficial layer of the true skin is destroyed, the *surface appearing* of a *grey-yellowish or brown colour*, not painful unless roughly handled. The vesicles that exist contain a blood-stained or brown fluid. The papillæ of the skin, with its nerves, are first destroyed; but, when in the course of a day or so, the dead surface has been "shed" and the nerves exposed, the pain is very severe, and the exposed surface has a reticulated surface.

Fourth degree.

In the *fourth degree*, the whole thickness of skin is destroyed, with more or less of the subcutaneous cellular tissue, the parts being converted into a hard, tough, dry, and insensible eschar, mottled with blood; vesication does not exist in this degree, all the superficial tissues having been destroyed. The skin surrounding the eschar may be blistered, but where it comes in contact with the injured part, it will be drawn into folds from the contraction, owing to the drying of the burnt integument; this puckering fairly indicates the important fact that the whole skin has been destroyed. The eschar does not begin to separate for four or five days, an inflammatory zone of redness with pain of some severity indicating the commencement of a process that will not be completed for two or three weeks. When the slough has come away, a long and tedious process of suppuration and granulation must be gone through prior to the repair of the exposed parts.

Fifth degree.

In the *fifth degree*, the skin with the deeper parts are involved—a black, brittle, charred mass taking the place of healthy tissues.

Sixth degree.

In the *sixth degree*, the whole thickness of a limb is carbonized.

These divisions originally made by the great French surgeon Dupuytren so well accord with all observation, that they have been invariably adopted by modern surgeons; and although, in burns and scalds, one degree passes imperceptibly into another, and in bad cases coexist, in the main, they can be made out.

Prognosis. On extent of surface involved.

Next to the *intensity* of the heat and *duration* of its application, the *extent of surface* involved is the most important point; indeed, as regards life, it is of far greater importance than the other two; because a superficial burn spread over a large surface—although not locally so injurious as a more severe one—is more fatal. In the majority of cases of death from burns and scalds, more particularly in children, the risk to life is fairly to be measured by the extent of surface involved; when more than half the body is injured, a fatal result generally ensues. A severe burn of a limited character may be, however, only a local affection.

Thus, the danger to life turns upon many points. In both young and old, all burns or scalds of any extent are serious. At any age extensive burns, however superficial, are to be feared, and they become serious from their immediate depressing effect upon the system; patients sometimes die from shock, and the very bad cases are marked by the sensation of *coldness* and persistent *shivering*. When the period of shock has passed, which varies from twelve to forty-eight hours, and that of reaction has set in, other dangers appear. Should the injury be over the thoracic cavity, chest complications may be looked for; and if over the abdomen, intestinal troubles. Burns and scalds of the head are not so likely to be followed by intracranial as those of the chest are by thoracic mischief. All intestinal complications should be carefully observed, as there seems to be a liability to irritation of the intestinal mucous tract, which may terminate at times in ulceration. Dupuytren first observed this in a general way, but Long ('Lond. Med. Gaz.,' 1840) and Curling ('Med.-Chir. Trans.,' vol. xxv) showed, that ulceration of the duodenum, as proved by inspection after death, and indicated during life by vomiting and purging of blood, is by no means an unfrequent result. Pathologists, however, are not unanimously agreed upon this point.

In the young and old more serious.

Intestinal complication.

In the *second* or *inflammatory stage*, the injured parts are being thrown off, and most writers allow for this process about fourteen days, though in some cases it is less, and in others more. When, however, the slough has separated, and the parts begin to suppurate, the *third stage*, or *that of suppuration*, has commenced. In this stage, although there may be less probability of visceral complications appearing, there is the equally great danger of exhaustion, hectic, or pyæmia. Should these risks have been surmounted, there is yet the long and tedious process of the healing of the granulating surface, and at a still later period evils arise connected with the gradual contraction of the cicatricial tissue. This contraction only takes place when the *whole* skin has been destroyed. When the surface of the skin merely has been involved, and not its depth, the sore, on the removal of the slough, has a peculiar net-like appearance with a whitish or yellow ground, through the meshes of which granulations project.

Casting off of sloughs.

Suppuration.

Granulation.

When a person dies from a burn within forty-eight hours, it arises from shock or collapse, pain doubtless often adding to its influence; when a similar result takes place during the stage of reaction or the inflammatory stage, it is from visceral complication; and when during the third or suppurative stage, from exhaustion, visceral changes, or pyæmia.

Cause of death.

When a person is said to have been "burnt to death," he dies from suffocation, the fumes of the fire destroying by asphyxia, and the fire subsequently burning the body.

Half the cases of burn admitted into a hospital die, and half of those that die, do so within the first three days.

The total deaths in England and Wales in a year from burns and scalds are about 2900, the females not being much in excess of the males.

Out of 408 cases consecutively admitted into Guy's, 275 were females, 143 males, the majority being children under five years old. Dr. Steele has also shown in his 'Septennial Report of Guy's, for 1868,' that out of 195 cases of burns from fire, 60 per cent. died; of 169 scalds, 16·5 per cent. died; of 18 burns from gas explosions,

Statistics of 408 cases.

11 per cent. proved fatal; and of 28 cases of burns from gunpowder, 14 per cent. succumbed, the difference between these classes of cases being very great, burns being four times as fatal as scalds, and these half as fatal again as gas explosions, &c.

Pathology. Pathology.—Holmes has gone into this question more thoroughly than any other author ('System,' vol. ii), and has given us an analysis of 68 fatal cases examined after death. Nine died from shock in the first two days, all being children; 17 from exhaustion, 5 within the week, and 12 at later periods. In 3 cases in which the scalp was burnt, erysipelas proved fatal; in 3 pyæmia, and in 2 tetanus. In 11 cases of children cerebral complications caused death, and in most of these the symptoms appeared soon after the accident. In 6 cases inflammation of the larynx proved fatal, evidently from the direct inhalation of the flames; in 12 cases, where in all of which the burn was thoracic, chest complications killed; in 4 only did abdominal mischief prove fatal, and of these one had peritonitis, the result of a deep burn, two had hæmorrhage from ulceration of the duodenum, and one had vomiting from the same cause.

Holmes and Erichsen also dwell upon the fact that cerebral and general visceral congestions are always present in fatal cases; indeed, in all, the congestion is a passive condition, due to the "sudden revulsion of blood from the surface," caused by the skin injury.

Ulceration of the duodenum. With respect to intestinal complication, it seems that out of Holmes's and Erichsen's 125 fatal cases, 16 presented ulceration in the duodenum, of which 5 died during the first week and 5 in the second, the situation of the burn in all but two being on the chest or abdomen. "The ulcer always has an indolent aspect, and is situated below the pylorus; often there are two or three close together; the edges of the ulcers are not raised nor everted; there is little or no evidence of inflammatory effusion in their neighbourhood; when they are recently formed, they look simply as if a portion of the mucous membrane had been cut out; but when the ulcer has penetrated more deeply, so as to threaten perforation of the gut, lymph may often be found effused on its peritoneal surface. Sometimes the glands of the duodenum may be found enlarged." (Holmes.)

The symptoms of duodenal ulceration are most obscure, as neither pain nor tenderness exists; diarrhœa is neither constant nor excessive; vomiting is perhaps a more common symptom; and the presence of blood in the motions is highly suspicious. When the ulcer has perforated the intestine, intense pain, vomiting of blood, melæna, collapse and abdominal distension, mark the fact.

It should be noted that cicatrised duodenal ulcers have been found in patients who have died of other complications.

Treatment of burns, &c. Treatment.—In all burns, great care should be observed in removing the clothes to save the cuticle. Blisters should be carefully punctured and their contents evacuated, the raised cuticle being gently pressed down to the true skin and covered by dressings. When the patient is cold, or shivering exists, he should be covered with a warm blanket and placed near the fire, some wine or brandy and hot water being administered. Professor Hebra speaks well of the warm bath under these circumstances. When the injury is extensive, one part should be uncovered and dressed before the other, as a free exposure of the surface tends to increase the shock and adds to the pain.

As pain is the constant accompaniment of all burns and scalds, and the

exclusion of the air from the injured surface the best means of neutralising it, the surgeon's object has ever been to find some method of treatment by which this result can be secured, and at Guy's Hospital the application of carron oil, consisting of equal parts of lime water and linseed oil, applied on lint and covered with cotton wool, has long been the favorite remedy, the whole being carefully kept in place by a bandage. At University College the burnt surface of whatever degree, is well covered with the finest wheaten flour by means of an ordinary dredger. At the London Hospital the application of zinc ointment on lint is employed. Dr. S. Gross, of America, uses white lead paint, and more recently, powdered clay has been employed. The dressings must not be changed for some days, not, indeed, until they have been loosened by the discharges or become offensive, inasmuch as the process of dressing any large burn is necessarily painful, and consequently injurious. To obviate the necessity of frequent changes of dressing, carbolic acid has been used dissolved in the oil, in the proportion of one part to ten or more.

Exclusion of air. Local applications

Small burns or scalds may be treated by water dressing, lead lotion, collodion, Friar's balsam, gold-beater's skin, flour, chalk and water, &c. Two parts of collodion to one of castor oil is also an excellent application. In superficial burns this treatment is probably all that is required, the cuticle being re-formed in three or four days, and beyond some increase of redness in the parts the cure is nearly complete.

In slight cases.

When the *first* dressing has been removed and the surgeon is able to make out the extent of tissue injured as well as the depth of the sloughs that are expected to separate, the character of the dressings may be altered, as it is best to hasten the sloughing process, which may be done by some stimulating dressing. Carbolic oil, made of one ounce of carbolic acid to a pint of olive or linseed oil, is very effective, or an ointment made of carbolic acid ʒiv, lard ʒiv, and castor oil ʒj; but these drugs will not avail when a very large surface is involved; and, under such circumstances they had better be applied to the sloughing parts, and the carron oil, or zinc, calamine, resin, or creosote ointment, mix of the last to an ounce of lard, to the other parts. A lotion composed of one drachm of the compound tincture of iodine to a pint of water is also beneficial. Sloughs, as they loosen, should be cut away, but never dragged. Deep sloughs are well treated by poultices, the turpentine ointment hastening their separation. When the surface is granulating it must be treated as any other open sore, and when the entire thickness of skin has been lost, as in burns of the fourth degree, the surgeon's closest attention is needed to counteract the contraction of the wound that will take place, thereby preventing the advent of those frightful deformities with which all are too familiar.

Use of carbolic oil.

Sloughs to be removed.

Prevent contraction.

This can be done by extension, applied in some instances through mechanical appliances, in others, by means of bandaging and strapping. When the latter is used, the pressure should be exerted over the granulating surface as well as over the cicatricial border. The strapping must be good and made of linen, thin calico and leather yielding too much; and in the majority of cases nearly all requirements can be met by these means. The process of extension must be kept up during the whole period of granulation and cicatrisation. Thus, in burns of the anterior surface of the neck the chin must be extended to the utmost from the sternum; in those of the thorax the arm must be

kept from the side; and where the groin and parts aronnd are involved, tho thigh must bc kept extended.

Skin grafting.

In addition to thesc mcans, we possess M. Reverdin's method of skin graftiug; a practice consisting of the transplantation of small portions of trne skin—these centres of cutification not only rapidly growing in healthy granulations, but having the power of imparting to the margins of the granulatiug tissue a skin-forming power which is as remarkable as it is beautiful to witness.

By these means large granulating surfaces may not only be rapidly healed, bnt healed without such a surface of cicatricial tissue as neccssarily exists after ordinary burns or scalds, and, therefore, without that tendency to subsequent contraction that appertains to cicatrices.

This treatment has introdnced us to a new field of surgery, which promises to make a large class of cases that were previously an opprobrium to our art as remediable as many minor affections.

It will receive due attention iu a later page.

When amputation necessary.

When a hand or finger, foot or toe, is charred, amputation must be performed; and where the soft parts are so injured as to slough, the same practice may be called for. The time and also the neccssity for operation in any patient's case must be left to the judgment of the surgeon.

Constitutional treatment of burns, &c

The constitutional treatment of burns iu the first stage is to *prevent collapse* by the judicious use of stimulants and exterual warmth; *allay pain* by local treatment and soothing drugs, such as chloral or morphia; *maintain the powers of the patient* by simple nutritious food, such as milk, beef tea, eggs, &c.; and *after* the stage of reactiou, when that of suppuration has set iu, to prescribe good food of all kinds and touic mediciue.

Complications are to be treated on ordiuary principles, always remembering that the iujury is depressing, and requires no additional depressiug influence in the way of treatmeut.

Thoracic complications may be dealt with by moderate doses of tartar emetic and salines, as well as uutritious and possibly stimulating diet.

Abdominal complications, with opium, alkaline remedies, such as lime water in bark, and simple diet.

For children au opiate is best given iu the form of thc opium oiutmcnt; while for adults, wherc the drug upsets digestiou, the same plan is a equally effective.

Scalds of the glottis will be considered in Chapter XVIII.

Effects of lightning.

Burns and accidents from lightning rarely occur in this country, aud average about twelve a year. In 1861 there were twenty-six, in 1862 twelve, iu 1863 three, and in 1864 six. Holmes, who has written a careful compilatiou ou the subject, tells us that a person struck by lightning is usually more or less completely deprived of consciousuess at thc time. This is sometimes a cousequence of the shock given to the brain, and is accompauied by more or less paralysis of motion and of common or special seusation. Occasionally, aud perhaps more usually, it is merely the effect of fright, and is then only trausient. This insensibility sometimes lasts for a considerable time. The paralysis by which it is usually accompanied may last for an indefinite period; iu onc case it lasted four months, in another three. It is more common in the lower than in the npper limbs. Other affectious caused by lightning are burns, eruptions of crythema or urticaria, loss

of hair over parts or the whole of the body, wounds, hæmorrhage from the mouth, nose, or ears, loss of sight, smell, speech, hearing, and taste, or, in rare cases, exaltation of these special senses, cataract, imbecility, or abortion. It sometimes leaves arborescent marks on the body even on parts covered by clothes, which have often been described as a kind of photograph of neighbouring trees or other subjects. Persons not killed on the spot usually recover, though some die from exhaustion; recovery can be hastened by tonic treatment; and galvanism is beneficial in paralysis. Burns caused by lightning are deep and obstinate; sometimes, however, they are mere vesications; and should be treated as other burns. Treatment.

In sudden deaths from lightning the shock to the brain is the cause; the heart is found flaccid and empty, the blood sometimes coagulated; and Taylor tells us, from Sir C. Scudamore's experiments, that in animals killed by electricity the same conditions existed.

The diseases and treatment of cicatrices.

Cicatrices or scars however produced, grow with the growth of the individual, and, at the same time, have a tendency to disappear, so that indurated scars may indeed, in time, become non-indurated. In small scars this is often observed, and even in larger it is so occasionally, the large cicatrices of burns becoming soft and pliable. As often as not, however, the opposite occurs, and the disposition to contract is very formidable, producing deformities of a frightful kind; those of the neck being, perhaps, the most hideous. The arm may be fastened to the side (Fig. 40), and I have seen in one case the head of the humerus displaced forwards beneath the clavicle, and in a second beneath the coracoid process and the development of the upper extremity arrested by the contraction. There is no limit indeed to the effects of such a powerful and constant force as that of cicatricial contraction. On cicatrices. Disposition to contract.

Fig. 40.



Axillary cicatricial web after burn.

Fig. 41.



Mode of applying extension after its division.

The surgeon is called upon not unfrequently to remedy these defects, and where his efforts are successful, the surgery is satisfactory, but too often the result is far from what is required. Operative measures.

The operation consists in the free division of the cicatrix and its subjacent tissues, the subsequent extension of the divided parts during the healing process, and the transplantation of different centres of "cutification" during the granulating stage, after the method of Reverdin.

Modes of performance.

In dividing the cicatrix the incision may be directly across the scar, running into healthy tissue on either side, or in the form of a natural or inverted V, according to the line of induration, the V flap being dissected from the tissues beneath; or a number of small incisions may be made, subcutaneous or otherwise. But in all these divisions the surgeon must remember that the seat of the contracting cicatricial material is in the subcutaneous tissue as well as in the skin, and that unless it also is divided no permanent good can be expected. It is on this point, and indeed upon it alone, that a prognosis can be based. The most favorable cases for operation are those in which a web of tissue connects an extremity with the body, or the chin with the chest, for such a web contains within itself most of the cicatricial material upon which the deformity depends, and on its division the whole will be freed. Great care is needed, however, in the division of these webs, for they often contain important parts, such as nerves and vessels that have been displaced by the contracting process.

Example.

Thus, in treating a case in which the right arm was fixed by a web from the axilla and elbow to the chest, the web seemed to be so cutaneous that I was half tempted to perforate with my knife and slit it up. Had I done so, in the position I had noted, I should have passed my bistoury, across the brachial plexus, artery, and biceps muscle—these parts having been completely drawn across to the thorax by the affection—and then been forced to amputate the extremity. I did, however, what I should always advise others to do — divide the parts carefully and deliberately, and thus steered clear of any harm. I brought also a piece of healthy skin from the posterior part of the wound and fixed it to the anterior, about the lower border of the axilla, thus dividing the large exposed surface by a bar of healthy integument, and kept the arm at a right line to the shoulder with a splint extending from the elbow to the hip. When the wound had assumed a healthy aspect I inserted ten pieces of skin the size of hempseed, and after this, cicatrisation went on with wonderful rapidity, the child recovering with a natural arm and movable cicatrix. In this

FIG. 42.



Effects of burn on neck, contraction of cicatrix.

case I have fairly indicated the points upon which a successful operation is to hinge:—Free but deliberate division of the cicatrix and subcutaneous tissue; extension from the first during the healing process, by some fixed mechanical appliance; and skin transplantation when the surface of the sore has assumed a healthy granulating surface; the surgeon, where he can, partially detaching a piece of integument from one side and connecting it with the opposite, in order to divide the wound, and thus increase its skin margin for granulation. Where a bend in a joint exists this practice is still more valuable. After the operation the wound should be dressed with oiled lint and covered with cotton-wool, as in a burn. Fig. 41 illustrates a simple method of applying extension of the arm after the division of an axillary cicatrix of great size, and Fig. 42 illustrates the effects of a burn upon the neck. Points to be observed in operation.

In *deformities affecting the jaw*, in which immobility of the bone has been produced, Esmarch and Rizzoli have proposed the division of the bone at the fixed side and the excision of a small wedge of bone, with a view of making a false joint. The operation is a sound one, and has been accomplished successfully by Mr. C. Heath and others. In suitable cases it should be repeated. Section of jaw in deformities.

Ulcerating cicatrices are not uncommon, for "new cutis and new formed granulations are neither so strong, nor have they the living principle so active in them as the old cutis" (John Hunter, 1787), and an old scar may break up and become the seat of an indolent sore when its possessor has been weakened by any fever or exhausting process. I have seen this repeatedly occur in cicatrices received in infancy of adults as they become old or feeble. In one case the cause of the scar was a burn, in another an injury, in a third an operation, but in all, the scars were alike, and they underwent the same degenerating process. These sores require to be treated by rest and local stimulants, the patient receiving tonics and good food to improve the weakened powers. In one case I transplanted with complete success. These "cicatricial sores" are, however, always obstinate, those over the ends of bones being unusually stubborn. Ulceration of cicatrices.

Warty and cheloid scars are classed together, because it is difficult to distinguish the indurated, lumpy, warty scar from the true cheloid. The former, however, appears directly *after* the wound has healed, and is clearly connected with the healing process, while the latter attacks any scar at any period of its existence. Warty and cheloid scars.

The thickened warty scar appears as an induration of the whole cicatrix and is often associated with heat and irritation. It is best treated by local stimulants, such as iodine or blistering fluid—the object being to break up, by some local inflammatory process, the lowly organised fibrous production.

Cheloid tumours grow as indurated smooth tubercles, at first having a red or pinkish colour, but as they increase becoming pale. They are at times painful, or, at least, irritable, and rarely attain a large size. They had better be left alone, for they are apt to return in the cicatrix formed after their removal. Cheloid tumours generally grow from cicatrices. These cheloid tumours are known as those of Alibert, to distinguish them from those described by Dr. Thomas Addison, who in 1854 ('Med.-Chir. Trans.') described another form of cheloid which he calls the "true cheloid," the induration beginning in the skin and On cheloid tumours.

subcutaneous areolar tissue, and often going on to produce such a contraction of the part affected as to resemble the indurated cicatrix of a burn. Figs. 43, 44 represent the two affections.

The cheloid tumour which follows the perforation of the ear for an ear-ring is a curious form, and seems less liable to return than others of a like nature; and from the deformity it causes it should be excised with a portion of the healthy lobule.

Cancer may attack scars.

Cancer may attack a scar, but when it does so the scars are generally old. Thus, I have treated a man who had a cancerous lip, the disease having developed in a scar he had had for fifty years. It began as a thickening of the scar, and then showed itself as a tubercle, which grew, broke down, and ulcerated, the ulceration rapidly spreading. Cancers in cicatrices mostly appear after this fashion, are usually epithelial, and are to be treated by the removal of the growth.

Fig. 43.



Cheloid of Alibert.

Fig. 44.



Cheloid of Addison.

(From models in Guy's Museum.)

Examples.

In December, 1871, I was called upon to amputate above the knee in a man, æt. 58, a leg stump that was the seat of a frightful cancerous disease which had existed for two years, and had appeared in the cicatrix of an old amputation performed fifty-four years before for gangrene after fever (Fig. 25).

Painful cicatrices.

Painful cicatrices are often due to the divided ends of the nerves being bound in by the cicatricial tissue, and as often as not they are caused by a bound-down bulbous growth at the extremity of a nerve. In a case I had some years ago the external popliteal nerve, as it wound round the head of the fibula, was so bound down by the cicatrix of a burn as to cause severe agony in the whole course of its distribution. The symptoms were relieved by two free vertical incisions through the cicatrix, and the patient recovered. Should I ever see a similar case I shall pursue the same course, except that I shall subsequently transplant pieces of skin in the wounds as soon as they assume a healthy appearance.

When the paiu is due to an adherent or bulbous nerve, the nerve must be freed and removed. When doubt as to its condition exists, Mr. Haucock's suggestion may be adopted, to divide subcutaneously the suspected nerve. Where no such causes as have been mentioned are to be made out, the case may be treated as one of neuralgia by full doses of quiuiue, arsenic, or iron, and local sedatives, the extract of stramonium or belladonua rubbed down with glycerine being good applications. Cases, however, of painful stumps or cicatrices are sometimes met with, that defy treatment. Treatment.

Congenital cicatrices are met with in practice. Thus, I have seen on two occasions a woman who had a cicatrix in her upper lip as if she had been operated upon for harelip (Chapter XII), and bridles connecting the lip with the gum in an unusual manner are not uncommon. Congenital cicatrices.

ON SKIN GRAFTING.

When John Hunter a century ago succeeded in transplanting the spur of a young chicken from its leg to his comb, as well as into the comb of a second bird, and found that it not only lived, but grew, he probably never dreamt in any flight of his genius that the fact which he then established would be so applied in the practice of surgery as to mark an era in its progress, and to bring a class of cases which surgeons were apt to look upon with little interest amongst the most curable and tractable of local affections. And yet this has come to pass, M. Reverdin, of Paris, on October 16th, 1869, having succeeded in transplanting small portions of skin taken from one part of a man's body to the granulating surface of a large sore, under which treatment the ulcer healed. He read the case before the Surgical Society of Paris on December 15th, 1869, and asked, "Is the growth of skin due to the effect of contact or neighbourhood, or is it due to proliferation of the transplanted elements?" Suggested by Hunter. Introduced by Reverdin.

Mr. G. D. Pollock of St. George's Hospital, encouraged by M. Reverdin's success, followed up the practice, and the good results he and his colleagues obtained soon induced all other surgeons to follow in their wake. The facts can be read in the 'Transactions of the Clinical Society' for 1871, and at the present moment it may now be considered as a well-established practice.

Since its introduction I have very extensively carried it out, and in most instances with success. I look upon the suggestion as very valuable, its adoption rendering many cases curable that were not so previously, facilitating the cure of as many more, and giving interest to a class of patients in whom formerly there was but little. In the management of ulcers it is a great boon, while in the treatment of the large granulating surfaces so common after extensive burns, its value cannot be overestimated. As an adjuvant to many plastic operations, more particularly on the face and in the case of deformities, it is invaluable.

Under the action originated by the transplanted fragments of skin, a process of repair goes on which at first appears almost magical; the grafts soon become islets of skin, round which cicatrisation proceeds; the margin of the sore receives an impulse in cicatrisation, which rapidly extends; and, between the grafts themselves and the margin of the sore connecting links of new skin rapidly form, which divide the Effects of operation.

sore into sections (Fig. 47). By these means large surfaces speedily cicatrise which under former circumstances would have required many months.

Moreover, the contractions and subsequent deformities that under other conditions were too well known to follow in such cases do not occur.

When applicable.

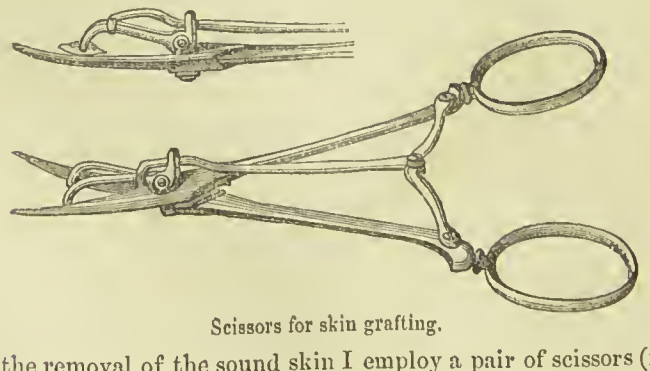
The practice seems applicable wherever a large granulating surface exists, and in its adoption the only desirable point to observe is, that the *surface of the sore should be healthy;* this clinical fact includes another —that the patient's health is good, for there is no better barometer of health than a sore, its surface assuming a healthy or unhealthy appearance with every alteration in the general condition of the body. I have attempted, however, by way of experiment, to graft skin upon sores that were not quite healthy, and have sometimes succeeded. In some indolent sores in which a small patch of healthy granulations sprang up, I have succeeded in securing a new centre of "cutification" by transplanting which proved of great value in aiding the healing process; in some others the graft has been enough to excite a more healthy action in the sore; still in many poor success followed the practice. It may, therefore, be accepted as a truth, *that a healthy granulating surface is an important although not an essential requisite for success in skin grafting.*

Upon this basis I now proceed to consider how the operation is to be performed.

Pollock tells us that Reverdin's method is to remove a very minute portion of the skin, place it on the surface of the granulations, and there retain it with a strip of plaster. He writes, "I have usually removed the skin by nipping up a very small portion with a fine pair of forceps, and cutting it off close with sharp scissors. At first I made a slight cut in the surface of the granulations and then embedded the piece of skin; but of late I have only laid it on the surface of the ulcer. I cannot say that I have found any difference in the result. I do not think there is great, if any, advantage to be gained by the transplantation of a large piece, but where the ulcer is large I think much is gained by the transplantation of numerous small pieces. The disadvantage of transplanting a large piece is the sore it creates; while the small sores formed by the removal of the minute pieces heal in a short time, and without trouble." ('Clin. Soc. Trans.,' vol. iv.)

My own experience in every point confirms that of Pollock.

Fig. 45.



Scissors for skin grafting.

Mode of performing transplantation.

For the removal of the sound skin I employ a pair of scissors (figured above) which Messrs. Krohne made for me after Macleod's suggestion

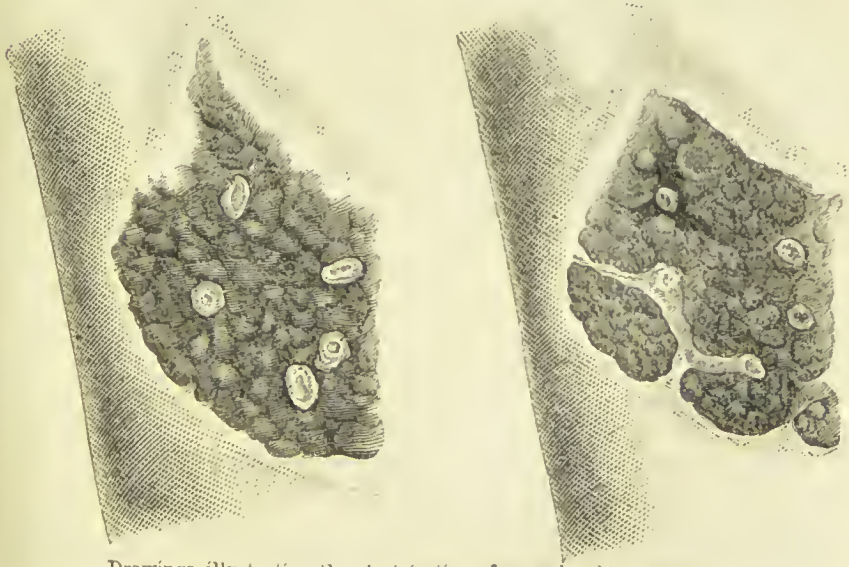
in a medical journal, and I find they answer far better than anything else, inasmuch as they take away a portion of skin that will cut into three or four pieces, and the section includes only the upper layer of the true skin, with the rete mucosum. They do not cut into the fat beneath the skin, nor divide the papillæ sufficiently far to draw blood or to give pain. Patients never object, with this instrument, to a second or third piece being taken away, should it be deemed necessary. The skin may, however, be removed with a fine lancet, either by perforation or after its elevation upon the point of a needle. I generally take the skin from the fore part of the arm or the side of the thorax.

Having taken away the skin, the fragment should be cut into three, four, or more pieces, and these placed about *half an inch or three quarters of an inch from the margin of the sore, and about one inch apart;* for there is no doubt that the engrafted centre has a stronger influence in exciting a healing action in the margin of the sore when placed near it, than when isolated in the centre of a granulating surface. Where to place fragments.

The pieces should be placed upon the granulations, and gently pressed in. There is no necessity to wound the granulating surface. They should be covered with a piece of oiled gutta-percha skin, and the whole supported with cotton wool; a bandage being subsequently applied, so as to press moderately upon the part, and keep the dressing in position. On the third day, but not before, the dressings may be removed with the greatest care, and a fresh piece of oiled gutta-percha skin should be subsequently applied. Not to change dressing till third day.

The appearances of the engrafted pieces on the removal of the first dressing vary considerably. At times they will seem palpably to have taken root and be alive; at others to have disappeared altogether; whilst in a third class the surface of the cuticle will be seen floating, as a thin film, upon the secretion of the sore, the basement membrane of the cuticle—the essential part—being left (Fig. 46).

Fig. 46. Fig. 47.



Drawings illustrating the cicatrisation of sores by skin grafting.

Care in removal of dressing.

Under all these circumstances, however, the surface of the sore is to be cleaned with the greatest care, a stream of tepid water, from a dressing can or squeezed from a sponge over the part, being the best means to employ. The surface is on no account to be wiped, for the grafted portions of skin are easily uprooted, whilst those that seem to have died or that have disappeared often show themselves again later as "cutifying centres." As soon as the sinew centres are established in large sores, other pieces should be engrafted, at about the same distance from the new pieces as those were originally inserted from the margin of the sore; and in this way the whole granulating surface may be speedily covered with new skin, and a rapid recovery follow.

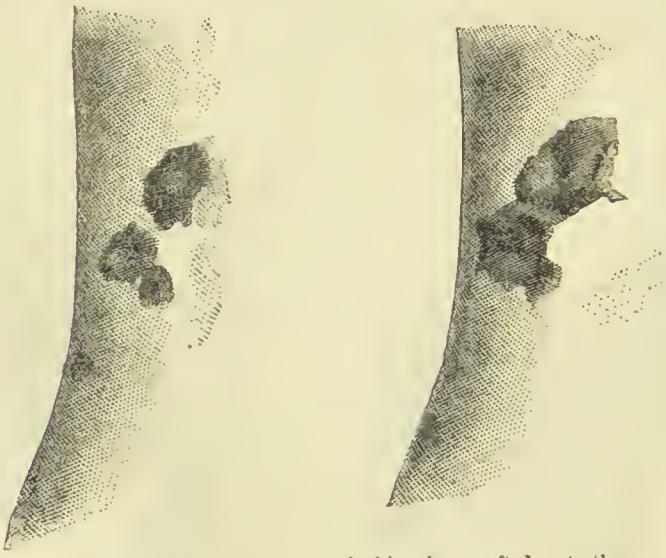
How engrafted pieces act.

How the engrafted pieces act in the healing process is not yet satisfactorily settled, and Reverdin's questions, already quoted, have not yet been completely answered. That they do act as direct stimulants to the sore itself and more particularly to the margin of the sore, there can be little doubt, for as soon as the "grafts" have taken, the margin of the sore nearest to them is seen to cicatrise and to send out prolongations of new cicatrising tissue to meet similar prolongations from the new cutifying centres: the sore in this way becoming subdivided by bands into smaller sores, and then rapidly healing (Fig. 47).

How engrafted pieces grow.

That the engrafted portions grow by the proliferation of their own cells is likewise proved by the fact, that in the case of a white man upon whose ulcerated leg I engrafted four small pieces of black skin, the whole being no larger than a barley-corn, the black skin grew twentyfold in ten weeks, to the extent illustrated in Fig. 48,

Fig. 48. Fig. 49.



Drawings illustrating the growth of black skin when grafted on to the sore of a white man.

gradually enlarging and sending out prolongations which joined, till one patch of black skin had formed, as seen in Fig. 49. The

ulcer healed as rapidly where the black skin was grafted, as where the white was placed. The engrafted pieces of new skin thus grow themselves by cell development, they stimulate the skin-forming powers of the margin of the sore, and exert at the same time a like action on the granulations around.

Pieces may be transplanted from amputated limbs.

The same result may likewise ensue when large pieces of skin, whether removed from the patient or from some recently amputated limb, are transplanted. The dressers at Guy's have frequently engrafted large pieces of skin, half an inch square, removed from amputated limbs; the pieces on removal have been dropped into warm water in their passage to the wards where they are applied. But there seems to be no advantage in this practice, and in the cases in which it has been adopted a large proportion have failed. In a case of mine the grafts took root and excited a healthy action in the margin of the sore; they, however, grew but little, and remained on the cicatrix of the sore, as bosses of skin with well-marked borders. They were grafted, it is true, but the grafts seemed to have no power of assimilating themselves to the tissues on which they were placed (*vide* Model Guy's Mus.).

Not required to take large pieces of skin.

To take large pieces of skin from the patient's own body is an objectionable practice on account of the large wound it creates, and, moreover, is unnecessary in the majority of cases, as small pieces appear to do better. To take them from another subject is also objectionable for like reasons; but still more so, on account of the difficulty that sometimes accrues from a want of power in the new graft to assimilate itself to the tissues on which it is placed, and from the risk that is necessarily run of introducing into the blood of the living subject some new or poisonous element; a risk which I believe it to be wrong and unjustifiable to run, and that I would not allow on my own person. For these reasons I have forbidden my dressers adopting the practice.

Risk in transplanting skin from other subjects.

In the case where black skin was transplanted, I did it with the full concurrence of both patients; indeed, both were rather disappointed that the operation could not be repeated. They were firm friends, and the link I formed bound them closer!

May cut the piece into minute fragments.

There seems, however, no objection to mincing the portion of integument which is to be employed into minute fragments, that is, into pieces the size of millet-seeds; the thumb-nail of the surgeon being the best table for the purpose. In children, where it is unadvisable to remove much healthy skin, and the surface to be covered is large, the plan is excellent, though I prefer pieces the size of half a hemp-seed, when they can be obtained. The practice of applying "skin-dust," or the products obtained by scraping the skin, cannot be recommended as it is rarely successful.

Properties of the newly engrafted skin.

Whether this newly engrafted skin possesses the same power of resisting disintegrating changes as the old skin is not yet proved. Some observations I have made lead me to suspect, that it is in some cases rather liable to break down and ulcerate as soon as the patient begins to walk after the sore has completely healed, whilst in others I have found a sore in this way healed is more capable of resisting disintegrating changes than another healed by unassisted natural processes. At any rate, it is necessary to observe as much care in the after-treatment of the case as ought always to be observed after the cure of any other sore; and more particularly to afford moderate support and pro-

tection to the part. For this purpose there is nothing better than to bind on a piece of sheet lead over the cicatrix when the seat of mischief is on the leg, as by it equal pressure as well as protection is afforded.

The new skin soon becomes as sensitive as the old; the sensibility of the cicatrix, under these circumstances, indeed, seems to be greater than when unaided cicatrisation is allowed to take place.

Chilblains.

On chilblains.

Chilblains are local inflammations of the skin, and are to be met with in subjects of a feeble circulation. They are more common in the young, and in women than in men, and are generally seen on the toes, fingers, nose, or ears, and are caused by any sudden change of temperature or any sudden application of cold or warmth.

They are simple congestions of the skin attended with tenderness or itching; vesication of the skin, when the inflammation is more severe; or sloughing and ulceration of the skin, when a broken chilblain occurs. The disease may begin and stop at the first or congestive stage, or run through all the stages—the experience of each subject telling him or her what is to be expected.

Towards evening the symptoms of irritation are always increased, and any external warmth, as of a fire or bed, any full diet or stimulating drink aggravates it; in fact, anything that excites the circulation in the part, at any hour of the day or night, is apt to increase the symptoms.

Treatment of chilblains.

TREATMENT.—The local treatment of chilblains is no less important than the general, and more successful; for whilst tonics, good diet, external warmth, and exercise are necessary to improve the general powers of the patient and the circulation, local stimulants are of great value. When the chilblain is not broken, the local application of the tincture of iodine, of a solution of sulphate of copper (three grains to the ounce), of camphor liniment, of soap liniment with opium, or one fourth part of the tincture of cantharides, of compound tincture of benzoin, or of simple spirit, not only gives comfort, but hastens the cure of the disease. The parts should also be covered with strapping spread on leather.

When the parts are broken, water dressing with the use of thick lint and oil silk or elastic tissue, are the safest remedies, stimulating lotions being used later when the parts are indolent in healing. Olive oil ℥ij, Acid, Carbolic. gr. x, and Ext. Opii ℥j, is a good formula.

Warm socks and loose shoes or boots are always indicated, but anything like pressure is most detrimental. Exercise also should be taken when possible, and an equal temperature ought to be maintained.

Frostbite.

On frostbite.

It has already been shown, that the sudden application of cold to any exposed part of the body of a feeble or depressed subject is liable to be followed by "*chilblain;*" and, when concentrated cold is applied, under these circumstances, for a period sufficient to arrest the circulation in a part, a "*frostbite*" is the result. Sudden and severe alternations of heat and cold under exposure, however, even in healthy subjects, may produce this result, and, in military life this fact is well known.

Local effects.

The first effect of cold upon a part is, a sense of numbness and weight with a feeling of tingling. To the eye, the skin will probably

appear redder than usual, and if the part be removed from the influence of the cold at this time, recovery may follow, or, in feeble subjects, a superficial "*chilblain.*" If the cold, however, be allowed to act longer, the parts will become stiff, and at last insensible, feeling "dead." To the eye they will assume a white and waxy aspect and be senseless to all impressions, the blood having been completely driven from the surface. When the cold has been suddenly applied, and is sufficient to kill the structure outright, the frozen part will have a mottled aspect, from the retention of blood within the tissues. Many of these effects may be produced by the æther spray.

Constitutional effects.

The *constitutional effects* of cold are at first stimulating, and subsequently depressing; excitement passing into sleepiness, and this into torpor. If the latter be yielded to, the sleep will end in death, the blood being sent from the surface of the body to the brain and other viscera, and death being produced by blood engorgement, as in apoplexy.

In the "sleepy and depressed stage" of cold, if the patient be brought suddenly under the influence of warmth, and placed too near a fire, the risks of lung engorgement, as well as of rapid gangrene of the frozen parts, are very great, for by sudden reaction the arterial circulation becomes quickened, and all the parts are gorged with blood which they have lost the power of propelling onwards. In gangrene from frostbites there seems reason to believe that ulceration of the duodenum may follow, as after burns. Mr. Adams has recorded such a case in the 'American Med. Times' for 1863.

Treatment of frostbite.

TREATMENT.—Few cases require more care, for any sudden alternation of temperature may be most injurious. The aim of the surgeon should be to recall the affected parts *gradually* to their normal condition, by assisting the venous circulation by gentle friction in the course of the veins with fur or flannel, and the arterial by comparative warmth applied externally, and gentle stimulants administered internally. Neither warm water, nor air, nor fire should be allowed to approach the parts until the natural temperature has been partially restored, and then only with great care. Friction with snow or iced water has been recommended. On reaction, the parts may be raised and lightly covered with flannel or cotton-wool, or exposed to the warm air of a chamber; whilst food and stimulating drinks are carefully administered, warm milk with a little brandy being the best. Should reaction be too severe, it must be checked by lead or spirit lotions.

When gangrene limited.

When gangrene follows, and only *small* portions of the body suffer, such as the integument, the parts may be dressed by some stimulating application to hasten the separation of the slough, and the part should be kept warm; carbolic acid and oil are probably the best applications; tonics should also be given.

When gangrene extensive.

When *large* portions of the body suffer, such as the whole foot, (and in this country I have seen a coachman, who had on new tight boots on a bitter winterday, lose both feet), amputation may be called for, the surgeon always waiting till the line of demarcation or limit to the sloughing process is fairly marked.

Boils and Carbuncle.

On boils and carbuncle.

These affections are, in a measure, allied, and are both due to inflammation of the skin and subcutaneous tissue, though the disease probably commences in the latter. In both there is effusion of lymph into the areolar tissue of the part, and in both this generally sloughs, although

in the boil, the slough is local and confined to one central point, while in carbuncle, the process may cover an extent of integument varying from the size of half a crown to that of a plate.

Boils of two forms.

Boils are met with in two forms: *one* as a subcutaneous swelling, attended with little pain until the skin over it inflames and suppurates. It then appears as a conical-pointed swelling, with inflamed indurated areola; this causes severe distress, until the parts give way, when the feeling of tension and throbbing is followed by relief due to the termination of the sloughing process, and discharge of the "core." When the slough has been discharged, an irregular orifice in the skin is seen covering in a cavity in the cellular tissue, which subsequently granulates, leaving a depressed cicatrix. The core or slough is composed of skin infiltrated with lymph.

The *second* form of boil begins as an inflamed follicle or pimple, which occasionally becomes vesicular, and has a scarlet, exquisitely sensitive areola. It suppurates slowly, and, as a rule, terminates with a less well-marked slough than the former kind. Such boils are more usually multiple than the other, and are often caused by the application of moist dressings, or of some cadaveric irritant.

Causes of boils.

With respect to the *causes of boils*, nothing definite can be laid down. That they are always associated with some debilitating or allied cause is belied by daily experience, for they are certainly often seen in men and women in whom no such condition exists, and in subjects who often declare that they "never felt better in their lives." As a rule, however, this is not the case, because they more commonly occur in subjects who have either been fed to excess or been subjected to some sudden change in the nature of their diet; such for instance as in men who undergo training for athletic pleasures, or who are subjected to the influence of fœtid animal exhalations, as met with in a skin-yard, pathological room, or dissecting-room. They are seen also in the diabetic and cachectic subject, as well as in patients enfeebled by any fever or other debilitating cause. Gamgee tells us that they are often the result of eating diseased meat. They are also produced by the local contact of certain cadaveric emanations; the newly appointed post-mortem clerks of our hospitals often falling victims, the poison acting at first as a direct irritant upon the follicles to which it is applied. They are far more common in some years than in others. In persons who are predisposed to their formation any local irritation is apt to produce them, such as the friction caused by rowing, the application of a poultice, water dressing, strapping, or a blister. They attack the integument of any part of the body, the palms of the hands and soles of the feet being apparent exceptions.

In the dense integument of the nape of the neck, buttock, and outside of the thighs, they are more chronic and painful than in the skin of looser texture. They are troublesome local affections, but seldom endanger life. In rare instances they are followed by pyæmia and death, but only in one instance have I known this to occur.

Treatment of boils.

Treatment.—The general treatment must depend upon the condition of the body and the apparent cause of the complaint, any unwholesome habit being corrected, and any evident want supplied.

Constitutional.

Under other circumstances the practice must be directed on general principles.

Diet.

The diet should be nutritious, but not to stimulating, exercise short of fatigue should always be allowed, and fresh air obtained when possible. The secretions should too be looked to, and, when out of

order, corrected, mild laxatives being often of service. When the skin is secreting unhealthily, the Turkish or warm bath is of great benefit; moreover alkalies or acids ought also to be given when the condition of the stomach needs them; alkalies and bitters are often of great benefit.

When debility exists, quinine is invaluable, and in London or large towns, its combination with iron is required. When diabetes is present, the "feeding" treatment is probably the best. Dr. Jackson, of the United States, gives twelve to sixteen grains of quinine a day, increasing the dose daily until its special effects are produced, and then decreasing it. He continues the treatment for a month. Yeast in doses of a table-spoonful, taken fasting three times a day, occasionally appears to have a rapidly marked beneficial effect, although in what way it acts it is difficult to say. Quinine. Yeast as a medicine.

The local treatment must be directed much by the local symptoms, it being, as a rule, a better course to let the boil discharge itself or dry up than to lance it. In the early stage of the papular or follicular form of boil, the free application of alcohol, spirit of camphor, the nitrate of silver, liquor potassæ, or iodine tincture, is often followed by its disappearance; but in the other kind all such applications are worse than useless. Local treatment.

When the pain is great from the tension of the part, and the areola of inflammation is spreading, relief may generally be given by lancing, and when the slough is slow in separating, the introduction into the opening of a point of potassa fusa is followed by the rapid cleansing of the wound and granulation. Poultices may be applied for a limited period during the sloughing stage, but not for any length of time, as they often encourage the appearance of others; water dressing is, however, generally preferable. When the local inflammation is not great, the plan of covering the boil with a piece of plaster with a hole in the centre, is very beneficial. At times, painting the areola with collodion or colloid styptic answers well. When boils succeed one another *seriatim*, without any definite cause, change of air is a most successful remedy. Incision when great tension.

Carbuncle.

This is a far more serious affection than a boil, for it is almost always met with in the feeble and cachectic subject, and generally in men, rich or poor, over forty-five. It is very frequently associated with diabetes, and gouty patients are particularly prone to its attack. On carbuncle.

It generally occurs singly, and is slow in its progress, the inflammation in the skin and cellular tissue beneath spreading as a brawny inflammatory effusion, with no defined border. The redness of skin is rarely vivid, more frequently livid; at times the local pain is severe, and constitutional depression very great. The sloughs separate slowly, many openings, as of many boils, allowing them to escape, and the whole skin at times separates as an ash-coloured layer, leaving an irregular cavity undermining the neighbouring tissues. The favorite seats of carbuncle are the skin and subcutaneous tissue of the nape of the neck, back, and buttock. They occur, however, on the front of the body and the extremities, and at times on the lip or face. The disease is so slow in its progress as at times to occupy many weeks, one part going through its course while the disease spreads in another. It may destroy life by exhaustion or by pyæmia; the worst form of pyæmia arises from it; indeed, M. Labat ('Med.-Chir. Soc. Bor- Situation. Slow progress.

deaux,' 1868) believes pyæmia to be the most common cause of death in carbuncle. Rare cases have been recorded in which peritonitis was caused by the extension of the disease from the abdominal walls into the peritoneal cavity.

When the treatment by incision is adopted, life is too often shortened by loss of blood. As a general rule, however, carbuncle is not a fatal disease. Its danger depends much upon its extent, and more upon the complications with which it is associated.

Treatment of carbuncle.

TREATMENT.—In former days the one form of local treatment that every surgeon followed was that of the crucial incision +, the knife being passed freely through the tissues to the base of the inflammatory effusion; the object of this was to give room for the slough to separate and come away. In modern times the value of this practice has been much questioned, for it was too often found to be followed by loss of blood, where blood was much needed; nor has it been thought that the incision did much to hasten the progress of the case or the separation of the slough. It is still, however, a popular form of practice. I was taught it, but after observing its effects have long given it up, believing that it did little or no good, and was often followed by a harmful hæmorrhage.

Incision deprecated.

Caustics preferred.

The treatment I prefer, and have adopted for many years, has been that by caustic, and the more I see of it the better I like it. It has been strongly advocated in this country by Pritchard, and in America by Dr. Physic. It is applicable in the stage of the disease when the cellular tissue is brawny, and the early inflammation of the skin has subsided; it may be used before any openings in the skin are found, either as Pritchard advises, by rubbing the caustic potash freely in the centre of the carbuncle until an eschar is fully formed, or, which is preferable, by puncturing with a scalpel, and inserting the stick or a small piece the size of a pea well into the diseased tissues. When the carbuncle is large, many punctures may be made, one to every area of surface of the dimensions of half a crown. Where openings exist, the surgeon has only to insert the caustic and allow it melt, either in the stick, or, what is better, in pea-like masses, by means of dressing forceps, passing them well down into the subcutaneous tissue. By this practice the slough is certainly cast off more readily than when incisions are made or the case left to nature. No bleeding takes place, and very little pain is given excepting at the time. With this treatment large carbuncles become soon healthy granulating wounds. The only care required is, to prevent the caustic running over the sound skin. During this treatment a poultice may be applied, or some lotion, such as Condy's fluid, carbolic acid, or alcoholic lotion; a solution of opium applied to the part often gives relief to pain. Tonics, good living, and fresh air, are also essential. The French surgeons prefer the use of the Vienna paste. By these means, unless the carbuncle is associated with some serious malady, such as diabetes or pyæmia, a good result may be looked for.

Caution.

Sub-cutaneous incision. Compression.

The plan of making a subcutaneous incision has been ably advocated by Mr. French and M. Guérin, and that of compression by Messrs. O'Ferrall and M. H. Colles, of Dublin ('Dub. Quart. Journ.,' 1864). The former plan I have tried, but have failed to find its advantage. The latter I have not employed, having been already well satisfied with the caustic treatment.

M. Gosselin strongly advocates the plan of making deep punctures into the carbuncle and evacuating them by means of compression.

The best thing, writes Paget ('Lancet,' 1869), you can do, if the carbuncle is small, is to cover it with emplastrum plumbi spread on leather, with a hole in the middle through which the pus can exude and the slough can come away. When the carbuncle is large he advises the common resin cerate, and over it a linseed-and-bread poultice; perfect cleanliness is to be observed during the sloughing process. Paget's mode of treatment.

Facial carbuncle.

This has been often miscalled "malignant pustule." It was probably first described by a clever young surgeon, Harvey Ludlow ('Med, Times and Gaz.,' Sept., 1852). It is generally found on the lip, the upper one being the more commonly involved, as an œdematous inflammatory swelling of the part, involving the nose and cheek, often preceded by some pustule or vesicle, and generally accompanied by them. It is almost always associated with severe pain. It ends, as do most cases of carbuncle, with sloughing, and at times the whole substance of the lip or cheek gives way. It is associated, like carbuncle, with great constitutional depression, and its special danger is thrombosis and phlebitis of the cerebral sinuses; the inflammation of the veins extends from the affected parts through the ophthalmic veins to the cavernous sinus. I have seen six cases of this affection, four of the upper and two of the lower lip, and all recovered. In only one did the disease extend beyond the lip, while in all, the disease, as far as local treatment was concerned, was left to natural processes, cleanliness and fomentations being alone employed. Tonics and good diet were given, and quinine with iron, in full doses, appeared the best. Paget advises quinine in sufficient doses to produce symptoms of cinchonism. On facial carbuncle. Treatment.

M. Reverdin, interne des hôpitaux, gives a very elaborate essay on this subject in the 'Archives Générales de Médecine,' 1870. At p. 162 of the August number he thus sums up his conclusions: Reverdin's conclusions.

1. Anthrax and furuncle of the face present a special gravity.
2. This gravity is due to the ready complication with phlebitis.
3. The facial phlebitis is attended with death, either by extension to the sinuses of the dura mater, or by becoming the source of purulent infection.
4. Of anthrax of the face, that of the lips is more frequently complicated with phlebitis than the others. This may be explained by the peculiar texture of the lips.
5. Anthrax of the lips has nothing in common with malignant pustule.
6. The involving of the orbit in the phlebitis, as demonstrated by exophthalmia, shows almost for certain the implication of the sinus.
7. Incision, speedily and extensively performed, seems to be the best means of preventing and sometimes of arresting the phlebitic complications.

Malignant pustule or charbon.

This is a disease of which I have had but slight personal experience. M. Bourgeois, in a work entitled 'La Pustule maligne et Œdème malin' (Paris, 1861), has given a full description of it. He tells us it is derived from an animal poison, and that it is communicated to man by direct contact with the body of a diseased animal, or with any material that has been in contact with the disease. It is On malignant pustule.

found chiefly on the exposed parts of man, such as the hands and face, and begins as a small, red, inflamed and itching spot, which in twelve or fifteen hours vesiculates, the skin beneath the vesicle appearing as a dry brown or black slough. In the course of the second day, another crop of vesicles appears around the original seat of the disease, which run the same course. About this time the seat of the original disease becomes more swollen, appearing as a defined lump ("bouton"), the parts around being œdematous, and the whole subsequently sloughing. In this stage of the disease there is little pain, the slough is always *dry, and there is no pus;* the sloughing spreads from the skin down to the subcutaneous tissue instead of as in carbuncle, from the latter to the former.

Mode of progress.

Malignant pustule is also rapid in its progress, four to nine days seeing its end. It is usually ushered in with rigors and symptoms of depression, followed by vomiting and *great* depression; often cold sweats and delirium occur, and the patient dies from the depressing influence of the animal poison before its local effects have had time to work. In young subjects, the prospects of recovery are greater than in the old, and, when the hands are involved, the chance is better than when the head is affected.

Treatment.

TREATMENT.—The disease being in its nature local, local treatment is to be preferred, and Bourgeois tells us, that the free application of some caustic, such as the potassa fusa, so as to destroy fully the primary vesicles in their early stage, is the best treatment; and, in more advanced cases the excision of the slough and the free use of the same caustic is to be recommended. Tonics, diffusible stimulants, and such means as are usually employed to guard against the tendency to death, are of great value.

Perforating ulcer of the foot.

On perforating ulcer of foot.

This affection was so called by Vesigné of Abbeville in 1850. It is an affection which Mr. Hancock has brought prominently before us in an able paper published in the 'Brit. Med. Journ.,' June 26th, 1869, although Cloquet, Boyer, and Nélaton, of Paris, have also described it. Nélaton says it "commences with phlyctæna in the pad of the foot. The epidermis is raised by a small quantity of purulent serum. Others describe it as commencing like a flat corn, which ulcerates. When this is opened, the subjacent dermis appears of a rose colour, and when touched is highly sensitive. This state may continue for some time, when the dermis in its turn gradually ulcerates. and a small fistulous opening is established in the subcutaneous cellular tissue, which will not heal, but continues to discharge serum slightly tinged with pus. If after five or six weeks the sinus is examined by a probe, the subjacent bone is felt rough and necrosed, and a sequestrum subsequently forms."

Nélaton's description.

The disease is probably hereditary, and is most obstinate in its character, generally spreading over years. It is, however, chiefly local, and confined to the anterior portion of the foot. Medicine has little power over it, although Fowler's solution has been much vaunted for its cure, still with insufficient evidence, and, as far as facts can guide us, it appears Hancock's conclusion is the only right one, and that is, that in the first instance, when dead bone exists, it should be removed. "But if, notwithstanding, the disease returns, there can no longer be a ques-

Treatment.

tion that when once perforating ulcer of the sole of the foot is established and recognised, it is better at once to remove the whole of the metatarsal bones, either by Chopart's, Syme's, or Pirogoff's amputation."

These cases are not to be confused with the suppuratiug bursæ or bunions found in feet deformed from short or tight boots.

Oriental Sore.

The Delhi boil.

The Oriental sore, which includes the Delhi boil, Moultan sore, Aleppo boil or Biskra bouton, seems to be due to the use of brackish, hard well-water (the Delhi well-water containing 45 to 50 grains of carbonate of lime per gallon); rather than to the presence of an animal parasite, as suggested by Messrs. Alcock and Fleming, of the Indian Army ('Med. Rep.,' 1868). It shows itself, says Sir J. Fayrer ('Practit.,' October, 1875), as an "intractable, indurated, indolent sore, papular in the early, encrusted or fungating in the advanced stages; spreading by ulceration of skin, single or multiple, often occupying extensive surfaces of the exposed parts of the body," and its secretion contains minute cell-growths, by which the disease is propagated. It may attack dogs and horses. Messrs. Lewis and Cunningham ('Appendix to 12th Report of Sanitary Commissioners with Government of India'), assert, however, that the disease is of the nature of a lupus, and should be treated as such. Indeed, they describe it as "lupus endemicus," 'Lancet,' April 7, 1877. It is to be treated by personal cleanliness, the avoidance of the use of *hard* water, the early destruction of the sore by the cautery or caustic, and the application of metallic astringents. Tonic treatment, a good diet and if possible change of locality and climate should be secured.

Mycetoma or the fungus disease of India.

The fungus disease of India.

This disease has been described by Dr. Carter, of Bombay, in the 'Trans. of the Med. and Phys. Soc.,' Bombay, 1861, and in a memoir published by Churchill, 1874, and is supposed by him to be due to the presence of a fungus. Other authors have thrown doubt upon this point, and amongst them F. B. Lewis and D. Cunningham, of Calcutta, who conclude that it is reasonable to infer that localised spots in the tissues undergo degenerative changes into a substance peculiarly adapted to the development of filamentous growths, the origin of which in situations where no spore could penetrate must remain matter of perplexity (M. J. Berkeley, 'Nature,' November 9, 1876), although the disease is well recognised. Berkeley observes, however, that the bodies found in the disease "so nearly simulate fungous growths, that it is difficult to get rid of the notion that they are really vegetable growths." ('Intellect. Observ.,' 1863.) The disease is more frequent in men than in women, and affects all classes, rich as well as poor, but it has never attacked a European.

The disease is chronic, and affects most commonly the foot, sometimes the hand, and but rarely other parts of the body. It is very slow in its progress, and has no tendency to get well if left alone. Usually it begins on the plantar surface of the foot or the palmar of the hand, as an induration in or under the skin; this subsequently softens down, a bleb then forms over the spot, and bursts, leaving a sinuous opening, from which exudes a thin, sanious, seropurulent discharge. As the disease progresses, other indurations,

followed by sinuses, form, till the foot or hand becomes one indurated diseased mass, riddled with holes the orifices of sinuses which may or may not lead to bone; and in extreme cases the bones are tunnelled. These sinuses discharge freely a putrid sero-purulent fluid, containing "fungus particles." The fungi are of two kinds, each, according to Dr. Carter, marking a variety of the disease. One, the dark or dark brown, is globular or ovoid in form, hard and friable in consistence, and of the size varying from a pin's head to that of a bullet. The other is pale or yellowish in colour, soft and cheesy in consistence, and of the size of a minute speck or pea. Dr. Carter and others believe that excision or amputation of the affected part is the only sound practice to be adopted.

Warts.

On warts.

These are growths of the papillæ of the skin, the papillæ being usually elongated and their epithelial covering thickened. They are common on the hands and other parts of the body of the young, and more rare in the adult. When on exposed parts of the body, they assume a horny hardness; but when surrounded with moisture or the secretion of the skin, they are soft and more sensitive.

Flat warts. Pedunculate warts.

The flat wart is called *verruca simplex*, the pedunculated *verruca digitata;* and these are said to be more common in the scalp. I have seen them on the neck, orifice of the nose, mouth, eyes, ears, and anus, also on the prepuce and labia. I have seen them also on the tongue. They occur at times beneath the nails and are very painful—*subungual.* The worst crop of warts I ever saw was around the anus of a boy.

The flat warts occasionally come and go in a way which cannot be accounted for; as a rule, they are, however, persistent. They rarely last into adult life, but when they do they seldom grow or give trouble. In exceptional cases, under some local irritation, they may increase and assume more the character of an epithelial cancer. When on the face this change is peculiarly liable to occur. Not long ago I destroyed an epithelial cancer by the ala of the nose, the size of a florin, that had suddenly appeared in a wart which had existed for sixty years, nearly all the patient's life, and I have removed from the lip of a man a cancer that had grown from a wart which had existed as long as he could remember.

Venereal warts.

Venereal warts are very abundant, whether they grow from the glans penis or prepuce of the male or labia of the female. They are pedunculated, moist, and highly vascular, and are clearly contagious. Warts, however, may occur at times in these parts without any venereal contact.

Treatment of warts.

TREATMENT.—Some powerful alkali, such as ammonia, to dissolve the cuticle, and the subsequent application of the glacial acetic acid, nitric acid, or acid nitrate of mercury, to destroy the papillæ, is the best plan to get rid of the harder or flat warts. Lunar caustic is an unsatisfactory and tedious remedy. Pedunculated *dry* warts should be cut off with the knife or scissors, and the *moist* may be treated in the same way when not too extensive. When, however, they are extensive, they may be made to dry up by the application of some powder, such as the oxide of zinc, or even starch. Powdered fresh savine is a good application, Mr. T. Smith recommending it to be mixed with the powdered diacetate of copper. The perchloride of iron in tincture is also serviceable.

Venereal warts and others, when extensive, may be readily destroyed by means of the galvanic cautery, the patient being under chloroform. At times excision is the best practice. In the large masses that are found on the genital organs of women, of venereal origin, nothing but the removal of the whole with the labium can be entertained; when the écraseur of the galvanic cautery cannot be obtained, the ordinary wire instrument may be used. The hæmorrhage from these venereal warts is generally severe; and the surgeon should never attempt to remove them by excision, when they are extensive, without having at hand some good styptic, such as the solution of the perchloride of iron, matico, alum, dry and in solution, or the cautery in one of its forms.

Moles.

On moles.

Using the word in the broad sense to include small spots of discoloured skin, and cutaneous connective tissue tumours with pigment, with or without unnatural growth of hair or skin glands, they are very common; few people being without one or more upon the surface of the body, while many have them in numbers. I have seen a woman studded all over with hairy moles, the hairs having been in some half an inch long and bristly. Moles are generally congenital, but at times put in an appearance later in life; they are rarely of any greater importance beyond the disfigurement they produce; occasionally, however, they degenerate or become the seat of a cancerous disease, the melanotic cancer having frequently its origin in such congenital spots. This clinical fact, which is now fairly recognised, is important, and renders it expedient for the surgeon to excise any mole that has a tendency to grow or to become indurated in middle life; for the melanotic is, as a rule, a soft cancer, and, when it has once appeared, is prone to spread and multiply rapidly. Many of the most virulent forms of multiple cancer the surgeon sees have their origin in moles.

May be the seat of cancer.

Corns.

On corns.

These are thickened cuticle, the result of *occasional pressure*, whether on the toes or feet, from tight or hard boots; or on the hands, from the mechanical irritation of tools, &c. It should be remembered that they are the result of occasional, and not constant pressure, the latter causing atrophy and absorption. Not only, wrote Hunter, "the cuticle thickens, but the parts underneath, and a succulus (bursa) is often formed at the root of the great toe, between the cutis and ligaments of the joint, to guard the ligaments below." This bursa forms under all corns when the pressure is not removed, in all old and neglected cases. A corn, when newly formed, can, by maceration, be elevated from its position as thickened cuticle only, the cutis being unaffected; but in old corns the cutis appears to atrophy, and the papillæ to disappear. Such corns, writes Mr. T. Smith ('Holmes's Syst.,' vol. v), "may be found based upon the fibrous tissue of the sheaths of the extensor tendons of the toes, all intermediate structures having been absorbed." When a bursa has formed it may inflame or suppurate, and give rise to troublesome conditions, such as will be described under "bunion."

Soft and hard corns.

A corn is called "soft" when it forms between the toes. It is far more painful and sensitive than the "hard;" it grows also more rapidly, probably owing to its greater moisture.

Treatment of corns.

Treatment.—Remove the cause and the disease will disappear.

This is a doctrine which applies to corns of all forms, when acted upon early. Boots which are too loose are as injurious as those which are too tight; where one presses the other rubs, the result being the same. A well-fitting boot, with a straight inner border and broad top, is the best. To remove the cuticle nothing equals warm water; and after soaking the part in it for some time, or keeping the corn covered for a night or more with water dressing and oiled silk, the whole may be carefully peeled off by means of a knife. After the removal of the corn, the skin should be protected by a piece of soap-plaster spread on leather. The application of nitrate of silver has been recommended. I have known it produce great pain, and, when applied to an inflamed corn, much harm; indeed, in one case sloughing of part of the integuments covering the little toe; in old people it is dangerous. The application of the glacial acetic acid is to be preferred. When suppuration takes place beneath a corn it should be relieved by a puncture as soon as possible, and water-dressing applied. Bursal swellings are to be treated as bunions. Soft corns are best treated by taking away pressure by means of the introduction between the toes of cotton wool, or undressed wool, and the use of some dry powder, such as the oxide of zinc; the corn soon becoming a dry one, and easily eradicated. Acetic or carbolic acid is a good application in obstinate cases.

Bunions.

On bunions.

Mode of formation.

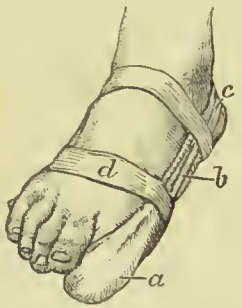
When from excessive or long-continued pressure a bursa forms over one of the tarsal or metatarsal articulations, a "bunion" is said to be present, and the most common seat for this affection is the metatarsal joint of the great or little toe. This fact is to be explained by the evil tendency which boots, as generally made, have to draw the toes together towards the central line of the foot. The central axis of the undeformed great toe being thus made to deviate from the normal line, which runs parallel with the metatarsal bone through the centre of the heel, to an abnormal one, in which the great toe itself, looking outwards, forms with the metatarsal bone at the joint, an angle pointing inwards, and the axis of the toe falls far within the normal one of the foot (Fig. 50).

Fig. 50.



Bunion.

Fig. 51.



Toe-cap for the cure of bunion.

Key's opinion.

Aston Key, however, attributes this deformity more to excessive weight received on a weak tarsus and metatarsus from over-standing; the great toe being gradually forced outwards by the oblique bearing of the foot on its inner plantar surface, when the arch of the foot has

given and the foot become flat. Too short boots greatly favour this change, the foot by such being compressed longitudinally, and the arch of the tarsus increased; the toes even being drawn up to form angles with the metatarsal bones—the great toe suffering the most. When bursæ form over the projecting bones, it is to save the joints from injury, and at times these form over the dorsum itself. Under extreme conditions the bursa may inflame and suppurate, giving rise to obstinate and troublesome sores. In still more extreme or neglected cases the joint of the great toe may be involved, ending in its destruction with or without exfoliation of bone.

Treatment of bunion.

Preventive.

TREATMENT.—When the nature of a bunion is understood, the principles of its treatment become clear. Preventive treatment is the best, and consists in maintaining the natural condition of the foot; in young children, and in girls especially, by guarding against the flattening of the foot from over-standing or walking during the period of growth, and against altering the axis of the great toe by keeping the inner line of the boot straight; and in no way by too short boots cramping the foot longitudinally.

Restore natural position of the toes.

When a bunion exists the only consistent treatment is that which tends to restore the misplaced toes to their natural position; when the great toe is involved, either by Key's plan of having a separate compartment made in the boot, so constructed as to keep it in a straight line with the foot, or by the simple apparatus given in Sayre's work on orthopædic surgery (Fig. 51), which consists of buckskin or linen caps to the toe *a*, a few inches of elastic webbing *b*, a piece of adhesive plaster to go round the foot *c*, and two circular pieces of the same *d* to retain all in position. Even in severe cases this practice may be successful, and in the old and confirmed cases the same is to be adopted; palliative treatment, however, is at times alone practicable.

The common plan, wrote Key in 1836 ('Guy's Hosp. Rep.'), "resorted to for the relief of bunion palliates the evil, in some degree, by removing the pain, and taking off the pressure; but it does not go to the root of the evil. The plasters on thick soft leather are agreeable to a painful bunion by keeping the skin in a pliant state, and by protecting the part from pressure;" but they do not cure the disease.

Removal of pressure.

Under all circumstances, pressure is to be removed; nothing like a tight boot ought to be thought of, a wide and easy one being worn. To the inflamed bunion water-dressing is the best application. Should suppuration take place, an early incision into the bursa should be made. In old people, however, some caution is called for in carrying out this practice, because in such, where from diseased arteries or other causes the circulation is feeble, gangrene of the part or a troublesome suppuration may arise. When suppurating sores exist, they may in the aged require stimulating applications; in the middle-aged, the bursa may be laid open and allowed to granulate, or be excised. In the early stage of a bunion the mechanical means suggested may be aided by the local application of a small blister, and Mr. Thomas Smith speaks highly of the local use of the biniodide of mercury, ten grains to an ounce. ('Holmes' Syst.,' vol. v, ed. 2nd.)

In the last stage, when the joint is destroyed, the case may have to be treated by incision of the parts, excision or even amputation.

In-grown toe-nail.

On in-grown toe-nail.

This is a troublesome and painful affection, and is more commonly met

Causes.

with on the onter side of the great toe-nail than on the inner, though it may oeenr in both plaees. It is usually eaused by external pressure npon the soft parts, the movable soft parts being pressed npon the immovable nail. As often as not, it is due to the eolleetion of eutiele beneath the edge of the nail, this entiele acting as a foreign body and by its pressure eausing uleeration. Uleeration having onee been set up, the healing proeess is prevented by the presenee of this entiele, together with the pressure of the edge of the nail, and the soft parts eovering it in Fnngous granulations, as a eonsequenee, frequently form, and eopious diseharge takes plaee, the affeetion being attended with severe pain.

Fungous granulations.

Treatment.

TREATMENT.—The disease being the result of pressnre applied from without in the shape of tight boots, or from within in the form of indurated eutiele beneath the nail, the surgeon's main objeet in the treatment is to take away the exeiting eause; and, when the eolleetion of eutiele exists, by the eareful introduction of a probe beneath the nail, to proeure the evulsion of the foreign body. In early examples of the disease this treatment is often sufficient. When external pressure has been the cause, and nlceration exists, the soft parts may be earefnlly pressed away from the sharp edge of the nail by the eareful introduetion beneath the overhanging integument of a small roll of lint, which should be well pressed down to the bottom of the sore, and fixed in position by means of strapping, applied so as to draw the soft parts away from the nail. This treatment, by removing all pressure from the sore, as a rule, being snecessful. When the fungous granulations are excessive, and the discharge profuse, the free use of alnm, oxide of zine, lunar caustie, the solution of the perehloride of iron, or more partieularly the powdered nitrate of lead before the application of the lint, is of great value. After one or two applieations of the lint, in the manner previously described, the soft parts will have been so pressed to one side as to expose the edge of the nail with the surface of the sore; and, nnder these circumstances the lint, or a pieee of thin sheet lead or tinfoil may be earefully introdueed beneath the edge of the nail, and the dressings renewed. Under this treatment a rapid eure readily ensues, and if no external pressure be re-applied, and the nail is allowed to grow np in its normal square form, there will be no recurrenee. In severe eases, where the soft parts so overhang the nail as to be nnaffeeted by the means here suggested, or, in which the nail perforates the soft parts (Fig. 52), the best eourse is to excise the overhanging integnment by means of a sealpel, for by this method the nleer is exposed, and all external pressnre at onee removed, the sore, as it heals, having a tendeney to contract, and thus considerably to diminish the ehance of a repetition of the affection.

In slight cases.

In severe cases.

FIG. 52.



Protruding nail

Removal of portion of nail.

When the nleer has spread far nnder the nail, it may be expedient to remove a portion of the latter to allow of eicatrisation; though, in a general way, to remove half the nail, to take away a V pieee from its eentre, to scrape or noteh it, are only temporary remedies. They may suceeed for a time, and allow the sore to heal, bnt it is eertain to recur in all

severity, as soon as nature has restored the parts which the surgeon has injured.

To cut the corner of the nail, under the idea that it is the offending body, is a futile proceeding; it may for the moment appear to be of service, but, in the end, it is injurious; indeed, the nail should be left square, as nature made it, and care should be taken to see that the soft parts are in no way pressed over its edge.

Onychia maligna.

On onychia maligna. Generally in children.

This is a disease of the nail matrix, and a far more severe and obstinate affection than the last. It is found most commonly in unhealthy children, and, as a rule, is started by some local injury, such as a squeeze. It commences as a swelling of the end of the toe or finger, with the other external signs of inflammation—redness, heat, and pain. These symptoms are soon followed by the exudation from beneath the nail of a serous fluid, which is often fœtid; the nail itself loosens, sometimes falls off, or either flattens out or curls up at its edges (Fig. 53). When this occurs, a foul ulcer is visible beneath. In extreme cases the affected parts assume a flattened bulbous form, and look as incurable as any local affection can well appear, and, in rare instances, the disease involves the last phalangeal joint or bone. It is never found in other than feeble and cachectic children. The worst case I have seen of this nature occurred in a child, æt. 10, in whom the fingers and thumbs of both hands were involved, and had existed for years.

Treatment.—In favorable and not extreme examples of this affec- Treatment.

Fig. 53.



Acute onychia.

Fig. 54.



Chronic onychia.

tion tonics internally and water-dressing externally suffice to bring about a cure; while in others more active local treatment is called for, such as the application of some mercurial lotion, as black-wash, or Abernethy's lotion (formed of the liquor potassæ arsenitis ℥ij to ℥j of

water) or, the red oxide of mercury ointment. In the case to which I have already alluded all this treatment failed, even after the evulsion of the nails—a plan of treatment that should always be adopted in obstinate cases. The cure was at last effected by making a clean shave of the dorsal aspect of the extreme phalanx, taking away nail and soft parts. This course was resorted to only after the disease had existed for five or six years, and had resisted every form of treatment, even to the repeated evulsion of the nails; the pain being agonising and demanding surgical interference. Fig. 54 was taken from one of the fingers of this patient. Professor Vanzetti, of Padua, strongly advocates the application of the powdered nitrate of lead to the ulcer, and my own experience of its value justifies me in strongly recommending it. Constitutional treatment with tonic regimen is always necessary.

The disease may at times have a syphilitic origin, when it will be wise to adopt specific treatment.

Other diseases of the Nails.

Arrest of growth of nails.

Under the influence of some acute diseases, the nails cease to grow, and the arrest becomes manifest, as convalescence advances, by a transverse groove in the nail, while the width of the groove denotes the duration of the arrested growth. As a result of hereditary syphilis Mr. Hutchinson has shown, that the nails may become completely ridged, while even in acquired syphilis, Hutchinson, Wilks, and Fagge have fairly proved that the nails may become narrow, thick, ill-formed bodies, or concave, rough, and black.

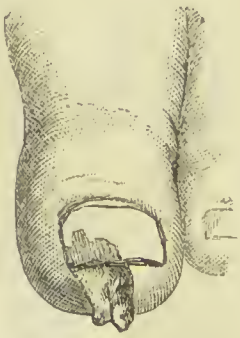
Ridged nails.

Psoriasis of nails.

Psoriasis affects the nails somewhat in the same way, the nail thickening and splitting vertically, and in *favus*, Fagge has shown that the part may become thickened and of a yellow colour from the interstitial deposit of the parasitic disease. Wilks, in the 'Lancet' for 1868 and Fagge, in 'Guy's Hosp. Rep.,' 1869-70, have written fully on these points. At times the nails become soft, and, in feeble subjects, very convex. This condition is said to be common in phthisical subjects,

Clubbed nails.

Fig. 55.



Horny growth from beneath nail.

Fig. 56.



Ungual exostosis.

but in surgical disease I have often observed the same condition appear during illness, and disappear as strength returned. I regard it only as an evidence of feeble power.

Horny growths occasionally spring up beneath the nail, as seen in Fig. 55, and ungual exostosis very frequently appears—which is, a bony outgrowth from the extreme phalanx of the great or other toe, as seen in Fig. 56. Both require excision. Horny growths and ungual exostosis.

ELEPHANTIASIS.

This term has been applied to two very different diseases, the *Elephantiasis Græcorum, or true leprosy*, and the *Elephantiasis Arabum, or Cochin or Barbadoes leg*. The former is probably constitutional, and appears as a tubercular affection of the skin, more especially of the face, attended with some loss of sensation. It is usually ushered in with slight febrile disturbance and local œdema. As it advances, the skin thickens and the tubercles multiply; the disease spreads, and involves the tongue, mouth, nose, eyes, and even larynx and lungs. In extreme cases ulceration and disease of the bones exist; the subjects of the affection dying from exhaustion, if not from suffocation. It is, happily, rare in this country, although it does occur occasionally; it is, however, common in Norway, in the Mediterranean, and in the Indies. Dr. Webster, in the 'Med.-Chir. Trans.' for 1854, and Mr. Day, in the 'Madras Quart. Journal' for 1860, give valuable information upon the subject, and Dr. Carter, in the 'Trans. Med. and Phys. Society of Bombay,' vol. viii, new series, enters fully into its pathology. Elephantiasis Græcorum.

The disease has been regarded as incurable, although, since the introduction of the Gurjun or wood oil by Dr. Dougall, of the Indian Medical Service, in 1873, better results of its treatment may be expected. The oil is used as an external application, made into an emulsion with lime water, in the proportion of one part to three, and should be well rubbed in twice a day for two hours at a time. It has also to be taken internally in two-drachm doses mixed with the same quantity of lime water twice a day. With this treatment the tubercles are said to soften down; and in their place watery blebs form, which burst and discharge a clear serous fluid, and then the induration gradually subsides. The oil taken internally is a diuretic and purgative. Gurjun oil.

To the surgeon the second form of elephantiasis, or the *Elephantiasis Arabum*, is of the greatest interest. It is possibly a local affection, and quite distinct from the true leprosy. It appears generally in one or other of the lower extremities, or in the male or female genital organs; showing itself as a general infiltration into the skin and subcutaneous tissue of an organisable material, whereby the integument becomes hypertrophied and greatly thickened. In advanced disease the skin falls into great folds, and, between these, fissures form, which subsequently pass into oozing ulcers. At times the foot and leg become the seat of extensive ulceration, which rarely cicatrises. Elephantiasis Arabum.

It generally begins with some febrile attack, and the affected part becomes the seat of an erythematous redness and swelling, which subsides, again to recur, and each attack leaves some extra thickening behind it. I have observed this very clearly in one case, and have no doubt that the erythema had some distinct relation to the disease.

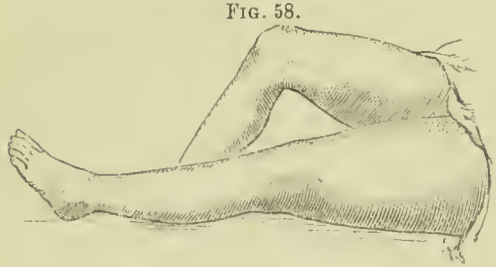
Dr. Wise, of Calcutta, in 1835, looked upon the disease as one of the

venous system, and inflammatory. Dr. Carnochan, of New York, believes it to be associated with an enlargement of the arterial trunks of the part, and upon this theory based his practice of tying the main artery of the limb, thereby starving the disease. Mr. Day, in the paper already alluded to, regards it as consecutive to malarious fever, while Mr. Dalton ('Lancet,' 1846) looks upon it as a constitutional disease, like the leprosy. From the many cases I have seen I do not believe in the theory of its being due to disease of the venous system, because pathological evidence is wanting to support the view, yet I am disposed to regard it as a true hypertrophy, and in this I am supported by the clinical fact that in some cases, though not in all, where the main artery of the limb is ligatured, and the vascular supply to the disease cut off, a recovery takes place.

Fig. 57.



Fig. 58.



Case of elephantiasis Arabum before and after the application of a ligature to the femoral artery

Treatment.

Carnochan, of New York, was the first surgeon to perform this operation (in January, 1851), and the success he met with, as published in a memoir on the subject in 1858, induced me to follow his example in 1865. My case in all its details was published in the 'Med.-Chir. Trans.,' 1866, and the benefit of the operation was most striking. It occurred in the case of a Welsh girl, æt. 25; the disease had been of two years' standing, and was spreading. The thigh of the affected limb (Fig. 57) measured twenty-seven inches round, and the leg nearly twenty-three, the affected leg being nine inches in circumference larger than the sound one, and the thigh seven. Five weeks after the ligature of the external iliac artery the calf of the affected limb measured seven inches less than it did at the time of operation, and when she left the hospital the limb appeared as in Fig 58. The rapid disappearance of the thickened tissue was very remarkable. Since the operation, the girl has gone on well, is companion to a lady, and can now walk ten or twelve miles. The limb becomes slightly œdematous only on over-exertion.

Example.

I have performed the same operation three times since, but not with similar success. I ligatured the femoral artery of a man who had the whole limb involved, the thigh being only slightly so, and, for a time everything promised to be as successful as in the case previously recorded; but an attack of erythema came on, followed by renewed swelling of the extremity, which never disappeared. In this case the size of the superficial femoral artery was extraordinary, the loop of the

silk ligature when it came away being capable of admitting a No. 12 catheter. The vessel seemed to be nearly the diameter of my finger and was very thick. In a more recent case, however, gangrene of the foot, followed by death, took place.

When this operation is performed the vessel should be ligatured well above the disease. I may add that Butcher in 1863 and Alcock in 1866 had successful cases; though Fayrer, late of Calcutta, and Buchanan, of Glasgow, have not met with successful results.

When surgical interference of this kind is not applicable, elevation of the affected limb or pressure should be employed. In severe cases amputation may be called for. Pressure.

ON PARASITES.

Guinea-worm.—The *Dracunculus* or *Filaria medinensis*, is one of the most troublesome parasites known in Africa, Asia, India, and tropical America. In Europe it is only occasionally met with in those who have visited the above districts. Guinea-worm.

The mature worm varies in length from two to six feet. It is cylindrical in form, white in colour, has a smooth surface, is tough and elastic; its mouth appearing as a circular orifice; and has no anus. How it enters the body is unknown, although it is evident that it does so from without, and probably through the skin of some part that has been in contact with water, inasmuch as it is more common in the feet than in other parts of the body, although the Madras water-carriers are said to have them in the back. At any rate, the worm gets into the subcutaneous areolar tissue, where it remains. Busk tells us that it does so usually for about twelve months, although it may be eighteen; when mature and the time has come for the discharge of the embryos with which it is filled, it makes its presence known by boring the skin, protruding its head under the cuticle, raising a bleb, and coming out bodily, discharging its young filariæ externally.

The first manifestation of the disease is usually a circular bleb, as Early symptoms.

Fig. 59.



Guinea-worm bleb just cut off. Dr. Druitt, 'Med. Times and Gaz.,' Jan. 3, 1874.

represented in Fig. 59, although it often happens that pain and stiffness of the affected part has been complained of for some time

Treatment. previously. The bleb contains sero-purulent fluid, and the surgeon, in order to find the worm, should cut the raised cuticle off. "There will then be seen protruding from a little hole in the centre of the denuded cutis one or more inches of the worm of the size and colour of vermicelli or of a wax match. The surgeon now makes a small quill-like roll of adhesive plaster, rolls the worm arouud it, and gently draws as much as will come without the risk of breaking; and this is repeated day after day, till at last the tail, which ends in a small hook, comes wriggling out, and the case is at an end." (Druitt, 'Med. Times and Gaz.,' Jan. 3, 1874.) Under these circumstances a rapid cure takes place. Should the worm break, a subcutaneous abscess is almost sure to form higher up; and when this is opened a loop of the worm can most likely be got out on a probe, and so be extracted as before.

At times no bleb forms, but merely a subcutaneous abscess. In exceptional cases more than one worm may exist. Druitt quotes a case in which nineteen had been extracted.

Considerable constitutioual disturbance often attends these local changes.

Sand-fleas. **Chigoe, Chigger,** or **Gigger,** or **Sand-flea.**—This is found in the West Indies and in South America, but the impregnated female only infects man. It makes its way beneath the nails or between the toes by means of its long proboscis, and, having gained an entrance, rapidly increases to a white globular vesicle the size of a pea. Some local irritation attends its presence. To prevent trouble, the insect should be carefully turned out of its bed by dilating the orifice through which it entered with a needle, care being observed not to rupture the globular vesicle which contains the ova, for if these escape iuto the cellular tissue the accident is often followed by tedious suppuration and ulceration.

Hydatid. **The echinococcus** or hydatid, the larva of the tænia echinococcus, is a common entozoon in the humau subject, and it may exist as a microscopical object, or as a cyst of many inches in diameter. It has highly elastic laminated walls, lined with a granular layer, and it is usually enclosed in the parts of the body infected by it in a distinct capsule, formed by exudation into and the consolidation of the surrounding tissue. It contains a clear, watery, nou-albuminous fluid, in which at times float some tænia heads or scolices, the so-called echinococci, or, in which are found the hooklets which surround the head.

These hydatids are met with in any part of the cellular tissue of the body—in the lungs, liver, abdominal cavity, pelvis, and even in the bones—a specimen exists at Guy's in which the spinal column was so affected. I have seeu them turned out of the breast, tongue, thyroid gland, pelvis, vagina, uterus, thorax, and bladder, and have removed a cyst containing them from the muscles of the neck, axilla, and thigh, as well as having treated many also in the liver.

At times au acephalocyst contains many secondary cysts. I removed a basinful from one occupying the pelvis, and they were of all sizes ('Path. Soc. Trans.,' vol. xvii). Hydatid tumours are to be recognised by negative symptoms; they appear as tense, globular, elastic swellings in a part, and give rise only to such symptoms as are to be explained mechanically by their presence; when dead they give rise to suppuration.

Symptoms negative.

Treatment. TREATMENT.—This must vary with the positiou, size, and growth of the hydatid tumours. When the parasite occupies some position in the

body outside one of its great cavities, and can be turned out of its bed by means of a free cut into its capsule, no better treatment is required. When it occupies one of the abdominal viscera or one of the serous cavities, it should be left alone, unless from its size it interferes with important functions or threatens life, but this point will be discussed in another page.

The cysticercus cellulosæ, the cystic scolex of the common tapeworm, is found in man, and is said to be the common parasite of the "measly pig." It has a quadrangular head, short neck, and cylindrical vesicular body; the head being surrounded with characteristic hooklets. It is found more particularly in the muscles and intermuscular tissue, and may affect the viscera as the former hydatid. It is known to occur in the eye, brain, heart, &c., and can be treated, when interference is called for, by an incision into the part and removal. Cysticercus cellulosæ.

Trichiniasis will be considered in the chapter devoted to the affections of the muscles.

SURGERY OF THE LYMPHATIC SYSTEM.

CHAPTER V.

INFLAMMATION OF THE LYMPHATICS AND THEIR GLANDS.

On inflammation of the absorbents.

The absorbent glands with their ducts, are liable to inflammation, "*adenitis*" or "*angeioleucitis*," and this action is probably the result of the absorption of some septic material. It is almost always associated with a wound, punctured or open, inflamed, suppurating, healing, or scabbing; with some point of irritation or suppuration, even a papule or pustule; with some centre from which morbific elements may be taken up. In what is called a simple wound the inflammation of the absorbents may be acute, but in poisoned it is violent and diffused. The inflammation always follows the course of the absorbents, leading from the centre of absorption towards the glands, that is, towards the body, and it never spreads backwards. When it has reached the glands, the diseased action ceases to spread; that is, it expends its force upon the group of glands in which the absorbents naturally end and does not extend through another series of absorbents to a second group. The morbific material is arrested in the glands, at least, such is the usual course of the affection. When pyæmia follows or complicates the case, it may be open to question, whether the poisonous fluid circulating in the lymphatics has not been allowed to pass into the blood through its usual channels, that is, through the inflamed glands onwards, but it is at least as probable, that the same septic material that poisoned the lymphatics and set up inflammation in the tubes and glands, was taken directly into the blood through the venous channels, thus giving rise to blood poisoning.

The glands acting as barriers.

Symptoms.

Absorbent inflammation usually manifests its presence in a definite way. Pain in some of the glands and tenderness are generally early symptoms, and, with these, or soon following them, will be seen a band of redness, varying in diameter, leading from the wound or infecting centre towards the gland. This red line may be continuous or interrupted; it may be a thin streak or a broad stripe of redness, and in some instances so radiate into the surrounding tissues as to simulate erysipelas. The whole line of redness is very painful, and with these local symptoms there will be also some febrile disturbance, very probably the attack will be ushered in with a rigor. It should be noted that the red lines follow the course of the absorbents and not of the veins.

May subside.

Under favorable circumstances and treatment these symptoms may subside, and the red line, with the swelling of the glands and cellular

tissue around the inflamed parts, together with the constitutional symptoms, will disappear.

In less favorable examples suppuration may take place, either as a local or diffused suppuration of the affected glands and surrounding cellular tissue; as a local abscess in the course of the lymphatics, or as a series of local abscesses. In extreme cases the suppuration may partake more of a diffused character, such as that already described as taking place in phlegmonous erysipelas. May suppurate. May be complicated.

With these local changes the constitutional symptoms will assume different features; the febrile disturbance probably being great, but marked by depression; rigors may repeat themselves at regular intervals, these generally indicating some suppurative process. When typhoid symptoms appear with rigors and sweating, the case has clearly become one of blood poisoning or septicæmia.

There are thus three different classes of cases: The three classes explained.

The simple, terminating in resolution; the more severe, ending in local glandular or lymphatic suppuration; and the complicated, marked by diffused inflammation and suppuration with general blood poisoning.

In the simple form, the poisonous element is probably of a diluted or but slightly irritating nature, and is generally some altered secretion of a simple wound due to external irritation. In the more complicated or severe forms, the poisonous element is of a more active kind, and has been either introduced from without in the form of a distinct animal poison, such as is derived from a dissection wound, or the bite of an animal; or is generated from within, as seen in puerperal cases.

Inflammation of the absorbents, erysipelas, phlegmonous or otherwise, and septicæmia, are all closely connected.

The effects of inflammation of the absorbents, however, are not constant or alike in all cases. In some the glandular enlargement alone is to be recognised, with more or less extensive suppuration of the glands and their surrounding connective tissue, without any external evidence of inflammation of the lymphatics leading to the glands. In others the red line of inflamed absorbents will be visible without glandular complication, or little more than a slight induration of the gland. At times there will be suppuration only along the track of the lymphatics but none in the glands, this suppuration taking the form of local abscesses. I have seen in a case of absorbent inflammation of the forearm and arm, four distinct abscesses in the line of inflammation, with only axillary glandular tenderness. The effects of inflammation of the absorbents.

Occasionally the lymphatics appear as a hard cord beneath the skin. In a case I had under my care some years ago this cord remained hard and contracted for many weeks after all signs of inflammatory action had ceased. It occurred in a gentleman who was in the habit at night of going through some simple muscular exercises, and in doing this, the cord in the arm snapped on the inner side of the biceps. I saw him a few minutes after the accident, and felt the two ends of it, which were apart for about an inch. Next morning the thin skin covering the anterior surface of the forearm was elevated, loose and baggy, from the effusion of fluid beneath it. There were no signs of inflammation or pain beyond local tenderness at the point of rupture of the lymphatic cord. In four or five days the fluid was reabsorbed, and convalescence restored, the hard cord gradually disappearing, and all traces of its separation becoming lost. I looked upon the The duct may be ruptured.

effused fluid as lymph that had been poured out by the divided lymph tube, and which had been taken up again. I have not seen a similar accident since.

Seat of absorbent inflammations.

This absorbent inflammation is most common in the extremities, though it may occur anywhere. There seems no doubt that a large number of the cases of glandular abscesses are of this nature. Pelvic abscesses in women are known to be of this kind, because pus has been found in the absorbents of the part.

Glandular suppuration in the neck is, from its position, a dangerous affection, the connective tissue of the parts being so loose, and the fascia covering them so firm, that burrowing suppuration often takes place. These deep-seated suppurations should be opened early, and as soon as any local evidence of pus exists; and in this way, viz. by cutting through the fascia with a lancet, and thrusting a director or forceps into the deep connective tissue. I have opened an abscess at the base of the tongue in this manner, from beneath the jaw, with an excellent result. The swelling affected deglutition and respiration, and threatened life.

Treatment of absorbent inflammation.

Local.

TREATMENT.—When any indications of absorbent inflammation show themselves, the wound or sore should be well cleansed, the scab removed, and any collection of pus let out. The affected limb should be raised, the foot, when involved, brought higher than the hip, the hand or elbow than the shoulder; and warm poppy fomentations should be applied along the whole course of the lymphatics up to the group of glands in which they terminate. Some surgeons, particularly the French, advise that the inflamed line should be pencilled with caustic, and dry warmth applied, such as cotton wool; but I prefer the practice already indicated, as it seems to give more comfort. Leeching is rarely, if ever, required.

As soon as suppuration appears, the abscess must be opened, whether this follows directly upon the inflammation or subsequently; inasmuch as suppuration at times is very insidious. At the very earliest period of the inflammation, when the tongue is foul, an emetic certainly seems to have some influence in checking its progress. It is a simple and valuable remedy. A good saline purge is also beneficial.

Constitutional.

Sedatives should be given to allay pain, such as small doses of morphia, three times a day, with a double dose at night, to induce sleep. When suppuration has taken place, tonics may be administered, and iron is the best.

In chronic cases, where induration in the track of the ducts remains, mercurial ointments and friction are sometimes valuable.

Enlarged glands after fevers.

Glands are very apt to inflame after fevers or the exanthemata; and particularly those in the neck. These affections often give rise to much local distress. In patients who are not extremely feeble these enlargements, as a rule, subside by themselves under careful management. In exceptional cases they suppurate.

Local warmth applied by means of cotton wool, tonics and nutritious food, are the best remedies; but when suppuration threatens, warm fomentations are more grateful to the patient. Abscesses should be opened early. Before opening, however, it is well to try what drawing-off the pus by means of the "aspirator" may accomplish, repeating the operation as the pus re-collects. In some instances a cure may be effected by these means, and thus a scar is prevented. Should it fail, an incision ought to be made.

Opening of abscess.

The local application of iodine under these circumstances, although a common remedy, does not appear to be of much value.

Chronic glandular enlargement.

Chronic glandular enlargement is a very common affection. When found in the so-called strumous subject the disease is regarded as a strumous one of the glands, yet it is very difficult to lay down any definite cause for its appearance. It is found in the strumous and feeble child, it is true, as a chronic and slightly painful enlargement of a gland or glands, more particularly those beneath the jaw and about the neck, and comes on sometimes after exposure to cold, some slight illness, local irritation, or without any definite cause, often subsiding spontaneously on the removal of the cause or on the improvement of the general health. There always exists, probably, some local cause of irritation. At times these glands suppurate and leave ugly sores, the cellular tissue around the gland becoming destroyed and the skin consequently undermined. The pus from these glandular enlargements is sometimes ill formed and curdy; and when it attends the breaking down of some old disease it may contain chalky deposit, this being some degenerated or dried-up tuberculous or other matter.

Hodgkin's disease of the glands.

Hodgkin's disease of the glands.

There is, however, another chronic enlargement of the glands that appears to differ in all ways from the local enlargements to which attention has just been drawn. It was first described by Dr. Hodgkin in the 'Med.-Chir. Trans.,' vol. xvii, and may be called Hodgkin's disease of the glands, or, for the sake of distinction, glandular tumours. He observed it first in the mesenteric glands, though any or all may be affected. In it the glands become very much enlarged, even to the size of an egg, and apparently more numerous; they present a smooth external appearance, and have a soft semi-fluctuating elastic feel. On section, the surface of the gland presents a smooth, bloodless, semi-transparent, loose, succulent structure; microscopically it is made up of glandular tissue and abundance of fibro-nucleated tissue; it is of a tough leathery consistence, and exudes a clear serous fluid. The tumours are always free, each being separable from the others.

Characters.

To the surgeon, the disease, at times, appears as a local movable glandular tumour of a slow painless growth, which medicine has no power of influencing; it has the local clinical appearance of a benign fibro-cellular tumour, and has often been excised as such.

In other instances the tumours are multiple, three, four, or more existing in one locality, chiefly in the neck. In exceptional instances the tumours are more numerous. I have seen a case in which, on one side of the neck, the subcutaneous tissue seemed filled with loose glandular tumours, readily movable one upon the other, as if simply confined by skin, in the same way as the adenoid tumours of the breast are occasionally met with. In still rarer examples the whole glandular system seems to be affected, every group of glands not only being apparently enlarged in size, but also increased in number.

This disease is often associated with an enlarged spleen, and appears pathologically to be allied to that blood disease now known as leuco-cythæmia, notwithstanding that in many instances the white corpuscles are not in excess.

On one occasion I had an opportunity of watching the gradual development of this affection. It began in the cervical glands, and gradually involved the whole glandular system, the boy, at the age

of fifteen, dying with an enormous spleen and glandular tumours in every region. His blood was made up almost entirely of white blood-corpuscles, death resulting from exhaustion.

Treatment of enlarged glands.

TREATMENT.—For the ordinary or strumous enlargement of the glands in children there is no drug equal to cod-liver oil, the syrup of the phosphate or of the iodide of iron, or, the tincture of quinine being capital additional remedies.

I have not much faith in the local application of iodine in the form of the tincture; as after the second application the skin ceases to be an absorbing surface, and the iodine becomes, therefore, a mere irritant. For some years I have been accustomed to order the solid iodine to be placed in a perforated box, and on a shelf in the sitting and bedrooms; the iodine in this way evaporating gradually and iodising the air. In all glandular, as in thyroid enlargements, this mode of employing the drug seems to be of considerable value.

The iodide of ammonium as an ointment is a useful application when rubbed in, the iodide by this process becoming absorbed.

Good food and fresh air are also essential points in the treatment of these cases.

Treatment in Hodgkin's disease

In Hodgkin's glandular tumours iron in full doses as well as cod-liver oil seem to be the best remedies; that is, patients who can take them appear to improve in their general health, while the disease does not progress so rapidly under their use as without it; but, upon the ultimate issue, no remedy seems to have any decided influence, and it always ends fatally in two or three years. When isolated glandular tumours exist they may be dealt with as local tumours and removed. This practice should, however, only be carried out when the tumour is in the way and interferes with life's value or usefulness. Under other circumstances they had better be left alone.

In all glandular enlargements, however, with the exception of Hodgkin's disease, the local cause of irritation should be looked into, with a view to its being removed; because, practically, it is well to regard all glandular enlargements as due to a chronic source of irritation, in the same way as acute adenitis is known to be a result of inflammation of the lymphatics.

Wounds of the lymphatics. Lymphatic fistula.

Lymphatics may be wounded by accident or by design, and no bad result ensue. At times, however, a fistulous opening that discharges lymph may remain. The same consequence may be the result of disease. Dr. H. V. Carter, of Bombay, has recorded three such cases in the 'Med.-Chir. Trans.,' vol. xlv, and Dr. Day another in the 'Clinical Soc. Trans.,' vol. ii. Through the kindness of the latter I had an opportunity of seeing his case. It was reported on by a committee of the society, and they confirmed the view taken of it. It was one of hypertrophy of one lower extremity of a boy, with the occasional discharge of chyle from vesicles, which were formed on varicose lymphatics. The hypertrophy had clearly an intimate connection with the distended state of the lymphatics of the limb.

Disease of the glands, as connected with cancer and syphilis, is referred to in the chapters devoted to those subjects.

DISEASES OF THE THYROID GLAND.

General remarks.

The thyroid is a ductless, yet highly vascular, gland, has as large a vascular supply as any gland in the body, and it is supposed to have some connection with blood formation. It is also freely supplied with lymphatics. It is also a lobulated encapsuled gland, with a cellular structure, the cells containing a glairy fluid. When it is simply enlarged it is said to be hypertrophied, or the seat of *goitre* or *bronchocele* (*simple adenoid enlargement*), and it is well known that these goitres attain a large size. Sometimes they are appareutly composed of simple increase of tissue, the enlarged gland having much the same appearance on section as the small and healthy one; at other times the structure of the tumour is coarser, more cellular, or cystic (*cystic enlargement*), the cysts occasionally assuming large dimensions; while in a third the glaud is more solid and fibrous, or more or less mixed with cysts (*fibrous or fibro-cystic disease*). The thyroid gland may inflame, as well as suppurate, and may be the seat of distiuct adenoid tumours, or of cancer. Hydatid cysts have also been enucleated from its body (*vide* Prep., Guy's Hosp. Mus. 1711[60]).

Varieties of its diseases.

Goitre.

Goitre, or Derbyshire neck, as it is generally knowu in this country, is very common. In its most usual form it appears as a simple hypertrophy of the thyroid gland, giving rise to symptoms which are attributable to the size of the tumour; when of moderate dimensions it may not be inconvenient, when even large it may be so, and still produce no symptoms worthy of special notice. At times, small tumours cause symptoms, such as dyspuœa, or the cough as of a broken-winded horse on exertion, and even difficulty in breathing on the slightest cause. At other times they mechanically press upon the large vessels and respiratory tract, producing headache and a feeling of fulness in the head on stooping or coughing, with evident respiratory obstruction, and even difficulty in deglutition. These symptoms may also appear for a time and then disappear, leaving the patient comfortable in all respects during the intervals. In other cases, goitres which appear to be of the simple kind begin to pulsate under excitement, or other unknown cause, and are attended with some protrusion of the eyeballs. These symptoms disappear with rest and time, and the case subsequently re-assumes the clinical features of a simple goitre.

Characters and symptoms.

They press on trachea and large vessels.

May pulsate.

May be attended with protruded eyeballs.

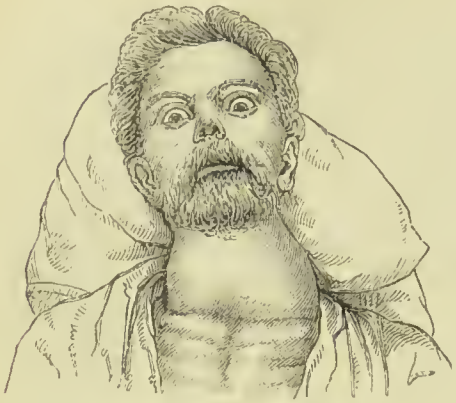
Such cases as these stand as a kind of link between the simple and that known as the *exophthalmic* goitre, Graves, or Basedow's disease; and yet, between these two affections there must be some wide difference, for the simple goitre appears to be a local affection, whereas the exophthalmic form is probably part of a more general disease marked by the enlargement of the thyroid body, often by prominence of the eyeballs, always by palpitation of the heart, a peculiar thrill in the blood-vessels, and a general want of muscular and brain power (Fig. 60). Modern notions tend to indicate that this form of goitre is a neurosis of the cervical sympathetic. "The numerous functional disorders which occur in Graves's disease are either due to temporary congestion of the sympathetic nerve, or a permanent structural alteration of the ganglionic nervous system." (Trousseau's 'Clin. Med.') This view, however, of the affection is not yet proved, and the whole subject requires investigation.

Exophthalmic goitre.

Treatment of goitre.

TREATMENT.—Simple goitres are to be treated on ordinary principles, viz. by attention to the general health, the inhalation of fresh air, and by tonic medicines. Filtered or distilled water should always be taken, more particularly in districts where chalk, lime, and magnesia abound. In Derbyshire and the Tyrol districts it is generally believed that it is from the water that the disease is produced. Iodine has always been held in high repute in this affection, originally as burnt sponge, and recently in the form of the iodide of potassium, and in four or five-grain doses, given with bark or quinine, this drug is of use. For some years, however, I have given tonics alone by the mouth, and have ordered the air of the room to be kept iodised by means of solid iodine, put into a box with a perforated lid, as already described; the metal thus evaporates steadily into the room where the patient sits and sleeps, and in this way it becomes absorbed. Under its influence I have often been surprised to find how rapidly goitres disappear. With this treatment I at times rub in an ointment of the iodide of ammonium, a drachm to an ounce. To paint a goitre with the tincture of iodine is useless, as one application renders the skin hard and incapable of absorption. Dr. R. Stoerk, of Vienna (1874), injects alcohol into the soft parenchymatous and cystic varieties; one or two drachms being introduced by means of a Pravaz syringe, turning the goitre hard by causing coagulation of its colloid contents. The injections should be repeated at intervals of several days, in different parts of the tumour. He, however, advises that a few drops of iodine should be added to the alcohol to prevent fermentation taking place. Dr. Lücke, of Berne, is in the habit of treating hard goitres by injecting strong tincture of iodine into the tumour, one or more punctures being made at a time, according to the size of the tumour, and he reports with good success. ('Lancet,' 1859.) Dr. Mouat, of Bengal, spoke ('In. Annals of Med. Science,' 1857) very highly in favour of the use of biniodide of mercury in combination with the rays of the sun, for the cure of goitre. He used the mercury as an ointment of the strength of three drachms to a pound of lard. It was rubbed in for ten minutes, an hour after sunrise, and the patient had afterwards to sit with his goitre held well up to the sun, as long as he could endure it. After this a fresh layer of ointment was to be applied with a careful and tender hand, the patient sent home, and the ointment left to be absorbed. In ordinary cases this treatment was said to have been sufficient to effect a cure, and that only in exceptional cases was a fresh application necessary. He gives his cases of recovery by thousands. It is possible that in this country the treatment has failed for want of the rays of the sun. I have tried it without the slightest beneficial result.

FIG. 60.



Exophthalmic goitre. Wilks' case.

Iodine.

Iodised air.

Biniodide of mercury.

In Graves's disease iodine appears to be not only useless but injurious. Tonics, more particularly iron, are apparently the most applicable. Tonics.

In exceptional cases a goitre may so increase and press upon the larynx and surrounding parts as to threaten life, and may even cause death by a gradual process of suffocation, but more commonly by exciting some sudden laryngeal spasm. In 1869 I treated such a case, sent to me by Mr. Holman, of East Hoathly, in which a large thyroid gland was causing chronic suffocation by its mechanical pressure, and it ultimately produced immediate death by exciting some laryngeal spasm. Dr. Herbert Davies has recorded a similar case ('Path. Soc. Trans.,' 1849), and in the Museums of St. George's and Bartholomew's Hospitals preparations exist with similar histories. May cause death by spasm of laryngeal muscles.

In some cases the treatment by setons has been of value, suppuration of the thyroid having been followed by a rapid subsidence of the hypertrophied or fibrous structure of the gland. Mr. Hey, of Leeds, adopted this practice with much success. In other examples of goitre the question of operative interference may have to be entertained, and will be considered in another page. Setons.

Cystic Bronchocele. On cystic bronchocele.

Cysts are often met with in this gland, and occasionally they assume large dimensions. They appear as more or less globular, tense, fluctuating tumours, moving up and down with the larynx, as all thyroid tumours do. They may contain only the glairy fluid of the gland, or a more serous or sanguineous fluid, or old grumous blood. Occasionally on being punctured they will go on bleeding even to the death of the patient. Such cysts appear either in one or other lobe or in the isthmus. In 1872 I treated, with Dr. Hess, a case of blood-cyst of the isthmus in a girl, and drew off about half an ounce of a thick, grumous, coffee-looking fluid. In 1863 I tapped a cyst, the size of a cocoa-nut, in the right lobe of the thyroid of a woman æt. 26, which bled profusely, and the hæmorrhage was only arrested by closing the wound. The cyst filled up at once nearly to its former size, but subsequently gradually contracted, and after five or six years scarcely any remains of it could be found. Simply tapping a serous cyst may cure it. When it fails, the cyst may be injected with a solution of iodine varying in strength from five to ten minims of the compound tincture to a drachm of water or simple alcohol. When these fail, a seton has been recommended, which is, however, a dangerous practice, and should only be adopted when simpler means are unavailing and further interference is requisite. In cysts of the isthmus, more particularly blood-cysts, an incision into the cavity is a good and successful operation. Should a cyst after tapping suppurate, it must be dealt with as an abscess, and freely opened as soon as the existence of pus can be made out, for the thyroid is in a dangerous position for suppuration to occur. I have successfully treated one case of suppurating thyroid cyst, after tapping by incision, but the cases in which this treatment is called for are rare. Characters. Contents. Treatment by tapping. Seton. Free incision

Dr. M. Mackenzie has ('Lancet,' May, 1872) advocated the practice of converting the cystic disease of the thyroid into a chronic abscess by the following means:—"First empty the cyst. When practicable, it is well to make the puncture as near as possible to the median line, and to select the most dependent portion of the tumour for the Mackenzie's plan.

introduction of the instrument. As soon as the trocar is felt to pierce the cyst-wall it should be withdrawn, and the cannula passed further in by means of a blunt-pointed key. The fluid having been withdrawn through the cannla, a solution of the perchloride of iron (two drachms of the salt to an ounce of water) is injected through the cannla by means of a syringe. The plug is re-inserted, and the cannla secured in position by a strip of plaster. The injection of iron is repeated at invals of two or three days, until suppuration is established. When this point is reached the tube is withdrawn, poultices are applied, and the case treated as a chronic abscess. Where the tumour consists of more than one cyst, it may be necessary to make a second or a third puncture; but it frequently happens that other cysts can be opened through the cyst originally punctured." Some cysts become calcarcous, and should be treated by excision. This practice is only, however, to be entertained when the cyst causes symptoms which threaten life. In Guy's Hosp. Museum there is a preparation of a calcareous cyst with an intra-cystic growth.

Cysts may become calcareous.

Inflammation of thyroid.

Acute inflammation of the thyroid gland is doubtless a rare affection. I have never seen such a case. Holmes Coote records one in 'Holmes's System.' Suppuration of a cyst in the gland after surgical interference is more common.

Acute hypertrophy of thyroid.

Acute hypertrophy may appear and produce dangerous, if not fatal symptoms. Dr. Risdon Bennett, in his interesting 'Lumleian Lectures for 1871,' has recorded such an instance, which I had the advantage of seeing, in consultation with him and Mr. Jackson, of Highbury. It

Example.

was in a young man, æt. 19, who, three months before, became the subject of paroxysmal attacks of asthmatic dyspnœa, associated at times with a wheezing or whistling respiration, and some general enlargement of the base of the neck. Three days before his death this difficulty became extreme, the paroxysms became more frequent and severe, and, on the day of his death a severe paroxysm took place, which passed on to a forced and heaving respiration, beyond anything I had ever before witnessed, and speedy death resulted. I performed

Required tracheotomy.

tracheotomy upon the patient, with the slender hope that some light might be thrown upon the nature of the case to guide us in its treatment, if not to give relief, but in doing so, what was probable before became evident then, viz.—that the obstruction was below. I had no perforated instrument with me long enough to force beyond the point of obstruction except a female catheter, which struck against some solid body that prevented its progress. After death the thyroid body was found to be much enlarged, and mainly below the sternum and along the sides of the trachea. The trachea below my opening was flattened laterally to within half an inch of the bifurcation; and was also twisted to the left, being surrounded by the greatly enlarged and firm lateral lobe of the thyroid. The structure of this enlarged gland was clearly that of hypertrophy, not of cystic or other apparent disease. As an example of acute rapid hypertrophy of the thyroid, the case, says Dr. Bennett, "points to the propriety of regarding any acute enlargement of this gland in young people with more anxiety than we are perhaps accustomed to do," particularly, it should be added, when the lobes of the gland pass down behind the sternum.

Thyroidal tumours.

Thyroidal tumours, doubtless, exist, although they are not common; these may be *adenoid* and innocent, or *cancerous* growths.

An adenoid growth may appear as a tumour within the gland itself, or connected with it, or more commonly as an intra-cystic growth, similar to that seen so frequently in the breast. In their clinical history such cases cannot well be diagnosed from the ordinary goitre, although, when the disease is unilateral, and assumes a rounded or irregular form, and appears to be an isolated outgrowth of the gland itself, the nature of the tumour may be suspected; when placed, however, within the gland itself, or within a cyst in the gland, the diagnosis is impossible. In the figure below (Fig. 61), taken from a drawing by

Characters.

Fig. 61.



Pedunculated thyroidal tumour.

Fig. 62.



Microscopical appearance of thyroid glands. (From Dr. Moxon's drawing.)

Dr. Moxon, of an old preparation in the Guy's Hospital Museum (1711[45]), a tumour the size of a grape is depicted hanging down loosely by a pedicle attached to a lobe of the gland. In the gland there is a well-marked, cup-like depression, from which the tumour had fallen out, the pedicle mainly consisting of a large artery emerging from the gland. The growth had an ossified capsule, and was composed of a structure like that of thyroid tissue (Fig. 62). My late colleague, Mr. Poland, has recorded a like case in which excision was successfully performed ('Guy's Hosp. Rep.,' 1871). Frerichs, Rokitansky, and Virchow record somewhat similar instances. Paget thus refers to the subject of accessory thyroid tumours: "These growths of new gland tissue may appear not only in the substance of the enlarging thyroid, but external to and detached from the gland. Such outlying masses of thyroid gland are not rare near bronchoceles, lying by them like the little spleens one sees near the larger mass. Their history is merged in that of bronchoceles (see 'Virchow,' lect. 22), with which they are usually associated, whether embedded as distinct masses in the enlarged gland, or lying close to it, but discontinuous."

Paget on thyroidal tumours.

Cancerous growths appear as infiltrating affections of the gland, or, as distinct tumours; they have no special clinical characters until they attack the surrounding tissues by continuity, or break

Cancer of thyroid.

down. The Guy's Hosp. Mus. contains four preparations of this disease.

Operative interference in thyroidal tumours.

On removal of thyroidal tumours.

Many operative proceedings have been suggested and adopted for goitre and thyroidal tumours. Sir W. Blizard, Earle, and Coates ('Med.-Chir. Trans.,' vol. x) tied the superior thyroid arteries, with the view of starving the disease, and Coates's attempt was attended with success, but the operation is necessarily a severe one, and the free arterial supply from the inferior thyroid arteries tends to neutralise its good. At the present day it is properly discarded. Setons have likewise been used with good success for this affection, and deserve a more extended trial. Excision, however, is probably the only operation that is worthy of consideration when any operative measure at all is to be entertained. It need hardly be stated, that no surgeon would venture to recommend the removal of a thyroid gland or tumour, unless life was jeopardised from its growth, and less severe measures had failed or were inapplicable; only under such circumstances is the attempt justifiable. That it can be done successfully has been proved by Dr. W. Warren Greene, of Maine; and in the 'American Journal of Medical Sciences' for January, 1871, two such cases are recorded. Mr. Poland's case, already referred to, is another in point, and more recently that of Dr. P. H. Watson.

Ligature of thyroid arteries.

Setons.

Greene's cases of excision.

Dangers of the operation.

Hæmorrhage is the chief danger to be dreaded in the operation, but if the fingers be well used to enucleate the growth, without dividing or cutting into its capsule, and if the pedicle containing the vessels which supply it be rapidly reached and ligatured, bleeding may be disregarded. As an extra point of caution it appears to be a sound practice to ligature before cutting all parts that require division in the same way as does the surgeon in ovarian cases, and for the same reason. Should the tumour turn out to be an adenoid growth, in or connected with the gland, as in Poland's case, it may be removed with comparative facility, and should it be an enlarged gland simply, even a pound and a half in weight, success may follow, as was proved by Greene's and Watson's cases. Indeed, I cannot do better than give the several steps of the operation in Dr. Greene's own words:

Steps in the operation of removal of thyroid tumours.

"1st. Exposure of the tumour by linear incision of ample length, avoiding most sedulously any wounding of the tumour or its fascia propria.

2nd. Division of the fascia propria upon the director.

3rd. The reflexion and the enucleation of the tumour with the fingers and handle of the scalpel, paying no attention to hæmorrhage however profuse, but going on as rapidly as possible to the base of the gland, and compressing the thyroid arteries.

4th. Transfixion of the pedicle, from below upwards, with a blunt curved needle, armed with a double ligature, and tying each half, or, when practicable, dividing the pedicle into as many portions as there are main arterial trunks, and tying each portion separately.

5th. Excision of the gland, and subsequent dressing of the wound, as in ordinary cases."

Dr. P. Heron Watson, in an interesting paper on the operation ('Edin. Med. Journ.,' Sept., 1873), strongly advises that "the investing fascial sheath of the thyroid should be left undivided until the mediate

ligature of the vessels included in their fine cellular sheath has been effected," and he proved by cases that this can readily be effected through the wound made for the removal of the gland. He condemns anything like roughness in the removal of the gland, and believes that the operation he advocates and had successfully performed in five cases, is easy, rapid in execution, and devoid of risk.

I cannot forbear, however, from quoting Dr. Greene's concluding remarks, which are so full of sound sense and wisdom. "I cannot refrain from one word of warning to my younger brethren, whose ambition may make their fingers tingle, lest they should, in the light of these successful cases, be too easily tempted to interfere with these growths. It is, and always will be, exceedingly rare that any such interference is warrantable, *never* for relief of deformity or discomfort merely; only to save life, and if it is, beyond all question, determined in any given case that such an operation gives the only chance for snatching a fellow-being from an untimely grave, be it remembered that accurate anatomical knowledge, and a perfect self-control under the most trying ordeals through which a surgeon can pass, are indispensable to its best performance." Greene's remarks.

SURGERY OF THE NERVOUS SYSTEM.

INJURIES OF THE HEAD.

CHAPTER VI.

CONTUSIONS AND WOUNDS OF THE SCALP.—BLOOD TUMOURS.—OSTITIS.

Injuries of the head are always of importance, and however trivial they may appear to be are never to be lightly treated. Although a blow upon the head may not be followed at the time by any symptoms of brain disturbance, and the only apparent result may be a simple cutaneous bruise, the bone may have suffered as well as the integument; as a consequence, grave results may ensue, since an acute inflammation of the diploë of the skull is a condition fraught with danger, and a chronic inflammation of the bone is scarcely less serious. When, moreover, as a primary effect of injury, evidence exists of brain disturbance, the importance of the case is increased, for brain concussion as a rule means brain bruising, and as a consequence the severest effects may follow the simplest accident. It is well for the student to have these truths impressed on his mind at the beginning of a chapter on injuries to the skull, for they have a practical bearing of vast importance. Preliminary remarks.

Contusions of the scalp and blood tumours.

The integuments of the scalp have this peculiarity, that they are intimately connected with the aponeurosis of the occipito-frontalis muscle; indeed, practically, these parts may be regarded as one, for they are not to be separated, and move together over the cranium. They are well supplied with vessels, and, consequently, have considerable power of repair, and rarely slough. A *simple contusion* of the scalp, not complicated with any great effusion of blood or other local injury, requires little surgical attention; it has a tendency to recover like contusions of other parts, although, when complicated with any great effusion of blood, difficulties arise. When any great effusion of blood complicates a contusion, a *blood tumour* is said to exist, and when this occurs on the scalp the affection is known by the term *cephalhæmatoma*. In newly born children this affection is frequently met with and it is commonly, although not always, a result of a difficult or instrumental labour. It is usually situated over the parietal bone, showing itself as a more or less circumscribed, soft, fluctuating tumour; but the largest I have ever seen, was over the occipital bone. When the tumour is small and confined to one bone, it is probable that the blood is effused beneath the pericranium. When the swelling is larger and spread over more than one bone, the effusion, doubtless, is poured out beneath the aponeurosis of the scalp.

Simple contusion.

Blood tumours of the scalp in newly born children.

In the former or *subpericranial form* the indurated base may organise, or inflammatory matter may be poured out around it, and assume the character of bone, more or less covering in the swelling; and, in neglected cases, suppuration, which occasionally passes on to involve the bone itself, may follow.

In the latter or *subaponeurotic form*, in which the blood is generally rapidly absorbed, a peculiar crackling sensation, which is very characteristic, will be often given to the hand in manipulation. In feeble infants this process of absorption may be delayed, or may fail altogether; under which circumstances surgical aid is called for.

In the adult, in addition to the forms of blood tumour just described as a consequence of injury, blood may be effused into the skin itself, and appear as a hard unyielding lump.

Blood effusions later in life.

When a blood tumour has an indurated base, rising from, and apparently continuous with, the bone, with a defined edge towards the centre, the idea may present itself that a fracture with depression exists. Under such circumstances the surgeon will be assisted in his diagnosis by firmly pressing his thumb or finger for a few seconds upon the ridge: this act in a recent case often displaces the fibrin, reveals the uninterrupted continuity of the bony surface, and thus proves the nature of the case. There will also be an absence of symptoms of fracture. When the case is complicated with brain symptoms or a ruptured artery, giving rise to pulsation in the tumour, some difficulty in diagnosis may be experienced.

Treatment.

Ice.

TREATMENT.—In an ordinary case of contusion or of blood tumour the best application is a cold or spirit lotion; muriate of ammonia, in solution, being as good as any. When a rapidly forming blood tumour exists, which feels tense or pulsates, powdered ice in a bag should be applied, the cold preventing the flow of blood and encouraging absorption. When the rupture of a large artery, such as the temporal or

occipital, is suspected, as indicated by the pulsation of the tumour and other symptoms, it may be advisable to apply pressure over the trunk of the vessel. When absorption of the effused blood does not take place, the cystic swelling should be tapped, the fluid drawn off, and pressure applied. This operation too may be repeated several times; the fluid often becomes serous. Should tapping fail, an incision ought to be made sufficient to allow of the free escape of the pent-up fluid and to prevent its re-collection; gentle pressure should also be subsequently applied on the part. In very obstinate cases the tumour may be treated as a serous cyst, and injected with iodine. When the effused blood breaks up, and causes suppuration—a somewhat rare result—a free incision is required and the case must be treated as one of abscess. During this period, tonic treatment is often required to improve the patient's powers. When the tumour is large, the patient should be kept quite free from excitement, and the diet carefully regulated according to the special wants of the case. As a rule, all such cases do well.

Pressure.

Tapping.

Tonics.

Scalp wounds.

Incised and lacerated wounds of the scalp are very common, and when not complicated with injury to the skull or its contents, generally do well. Blunt instruments, forcibly applied, produce scalp wounds very like those caused by sharp-cutting ones. Wounds which exhibit entire hair bulbs projecting from the surface of their sections have been probably produced by a blunt instrument., while on the other hand, when the hair-bulbs are found cut, the wound has to a certainty been caused by a sharp one. (*Vide* paper, 'Glasgow Med. Journal,' January, 1876, by Dr Wm. MacEwen.) Large portions of the scalp may be torn away from its connections with the pericranium or bone, and on readjustment live, though much bruised and injured, the extreme vascularity of the scalp favouring its repair, and the subject of the injury may recover without a bad symptom. It is generally thought that these wounds are especially "liable to prove the exciting cause of erysipelas." I am disposed to doubt the accuracy of such an assertion, because from my notes of 175 cases of scalp wounds admitted consecutively into Guy's in eight years—and it must be added that only the severe are admitted—I find that erysipelas followed only in three, or in 1·71 per cent., this proportion being about the same as that obtaining in surgical cases generally (*vide* p. 44).

Incised and lacerated wounds.

Erysipelas after scalp wounds.

Lacerated or contused wounds of the scalp rarely slough, and should be treated as the incised. Punctured wounds are, however, liable to be followed by diffused inflammation beneath the scalp.

Punctured wounds.

Treatment.—Under all circumstances and conditions, scalp wounds should be gently and carefully cleaned with tepid water, and their edges adjusted and maintained in position. The hair should be removed in the neighbourhood of the wound, and the head kept cool. When the wound is not extensive, and its edges can be adjusted by strips of plaster, sutures are not needed; but when any difficulty is experienced, they may be as fearlessly applied to the scalp as to other parts; in extensive lacerations, indeed, the application of sutures is decidedly preferable to any other form of practice, inasmuch as with their use the wound can be kept clean and moist by water dressing, which is not possible where a quantity of strapping has been employed. In the

Sutures.

Mode of application of sutures.

application of the suture, however, care must be taken not to include the aponeurosis of the occipito-frontalis muscle, for there is more danger of setting up mischief in the cellular tissue beneath this tendon, when this practice is adopted, than when the sutures simply pass through the skin itself. The kind of suture is unimportant, although many surgeons prefer the metallic. All sutures should

Their removal.

be removed on the second day, as wounds of the scalp heal rapidly.

When the pericranium is torn off and the bone exposed, no difference in practice is needed, the prospects of a satisfactory recovery under these circumstances being as good as in a less complicated case. When the bone, however, has been much injured superficial necrosis

Diffused suppuration beneath aponeurosis.

may follow. Should diffused suppuration occur in the cellular tissue beneath the aponeurosis, the sooner a free escape is given to the matter the better, as such cases are always attended with great danger to the periosteum, to the bone, and even to the life of the patient.

Treatment.

To attain this end the edges of the wound should be separated in parts, or *limited* incisions made through the tissues to the bone. By adopting this practice early, the extension of the inflammation will often be checked, and the extent of sloughing of the cellular tissue limited. Warm fomentations and water dressings should always be applied.

Prognosis.

When extensive sloughing takes place, there is no reason why a good recovery should not follow, if the powers of a patient are good and the kidneys sound.

Constitutional treatment.

The powers of a patient must be kept up by tonic medicines, such as iron or quinine, generous diet allowed, and stimulants employed when needed. Sedatives to procure sleep are also essential.

Hæmorrhage and its treatment.

When bleeding is troublesome, the arteries should be twisted, acupressed, or ligatured; when it occurs merely as a general oozing of blood, pressure may be applied either to the wound or to the trunks of the supplying vessels. In rare cases where the deep vessels of the temporal fossa are wounded and bleeding cannot be arrested, the question of applying a ligature to the external or common carotid may have to be entertained. It has never fallen to my lot, however, to witness such a case.

Contusion of the bones of the skull

Contusion of bone.

is, doubtless, a common consequence of scalp injuries both with and without a wound; so too is scratching or abrasion of the bones frequently combined with a laceration of the scalp. In the majority of such cases a good recovery takes place, it being the exception that a different result is met with and that acute inflammation of the bone with all its dangers, or chronic inflammation with all its difficulties follows.

Acute and chronic inflammation of bone the results of contusion.

Acute inflammation of the bone is a severe affection, more particularly when the diploë is involved; for the diseased action may extend inwards, giving rise to a local suppuration between the bone and the dura mater, or it may involve the arachnoid, and occasion a diffused inflammation of this membrane and the brain itself.

A chronic inflammation of the bone may be followed by very similar results, or, by a thickening of the injured bone.

During the progress of necrosis of the skull, these results are always

liable to occur, accompanied by a low kind of phlebitis of the cerebral sinuses and pyæmia.

The symptoms which indicate either of these two conditions generally appear two or three weeks after the accident, and vary in intensity according to the action. In acute disease there is more constitutional disturbance and headache, passing on to general brain disturbance, convulsions, paralysis, coma, and death. In chronic disease the general symptoms are less severe, and the local milder, but persistent headache is always present. When the inflammation spreads inwards towards the arachnoid and brain, other symptoms show themselves, such as severe local pains to delirium, twitching of the muscles, convulsions, paralysis, coma, and death; the rapidity of the progress of the disease governing the symptoms. When marked rigors appear, suppuration is indicated, often of the pyæmic kind; and convulsions of an epileptic nature are frequently found in the chronic form of the disease. *Persistent headache* after an injury to the head is always a symptom demanding anxious attention, as it too often means progressive mischief within the skull. This subject will however receive further elucidation in the chapter on intra-cranial inflammation.

Symptoms.

Persistent headache.

INJURIES OF THE CRANIUM.

There are some leading practical facts or principles which should be impressed upon the memory of every surgeon who has to deal with injuries to the head. These I have formulated as follows, believing it to be well to place them at the beginning of a chapter on such injuries.

1. A concussed brain should be regarded as a bruised one.

2. Fractures or injuries of the skull are of importance so far as they are associated with damage to the skull contents; a compound fracture uncomplicated with shaking of, or injury to, the cranial contents, being less liable to be followed by bad results, than a simple fracture associated with brain mischief.

General propositions.

3. The amount of injury to the brain cannot be estimated by the severity of the primary symptoms; a severe injury to the brain being frequently associated at first with slight symptoms and a slight injury with severe symptoms.

4. The character of the accident and the mode of its production furnish the best means for estimating the nature and severity of the injury, and its probable results; since a fall upon the head from a height or a blow from a heavy weight causes a *general* injury of the brain; and a fall upon or a blow from a sharp instrument a *local* one.

5. A general shaking (concussion) of the brain, whether associated or not with simple or compound fracture, may give rise either to temporary suspension of brain functions, ending in recovery; to laceration of the membranes; to a more or less severe bruising of the cortical structure of the brain; or to laceration of its deeper substance; the amount of hæmorrhage complicating the case depending upon the size, number, and healthiness of the ruptured vessels. Thus a general shaking or concussion in a healthy brain may only produce a temporary suspension of cerebral functions, when the same injury in an unhealthy or aged one, in which diseased vessels ramify, may be followed by a fatal hæmorrhage or apoplexy.

6. Under certain conditions of the system, a slight concussion will be followed by a fatal secondary inflammation of the brain-coverings, while under other conditions a severe injury to the brain will be followed by no such result; in the former case the kidneys are generally diseased.

With these general propositions which the student should learn and think over as a guide, I now proceed to consider the subject of fractures of the skull.

FRACTURES OF THE SKULL.

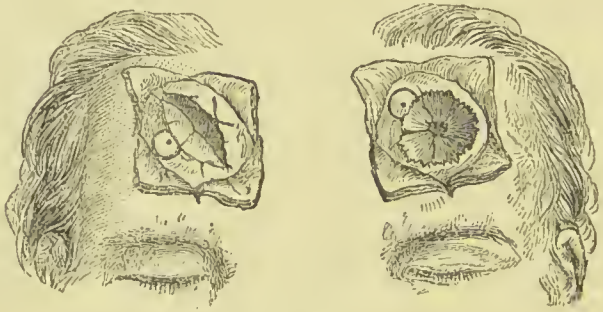
Varieties.

These may be divided into fractures of the *vault* and fractures of the *base*, a third and large division including those of the *vault and base*. They may likewise be *simple* or *compound*, *comminuted*, *depressed*, or *undepressed*.

Fractures of the vault are generally caused by direct blows upon the part, or falls upon sharp bodies. They include most of the *punctured* fractures and *incised* wounds of the bone, as in sword wounds, &c. They are very frequently compound and comminuted, and the brain injury which is associated with them is for the most part local.

The fracture may appear as a simple fissure, the extent of which is determined by the amount and character of the force employed, the line of fracture being influenced by the sutures and ridges of bone. When

FIG. 63. FIG. 64.



Gutter- and saucer-shaped fractures of the skull.

Starred and comminuted.

the force is local and moderate, the fracture may be limited; when concentrated and severe, the fracture will be "starred" and generally "comminuted," the fissures radiating in all directions, involving many bones, and passing downwards towards the base. When inflicted with a blunt-edged instrument, the fracture will be depressed in a gutter shape (Fig. 63); when with a round one, as a hammer, the bone will be smashed in more like a "saucer" (Fig. 64). When the fracture has been caused by a fall from a height upon the vertex, or by a blow from a heavy body, the bones of the vault and of the base may not only be fissured but displaced, and the sutures even may be dislocated.

Comminuted fractures are generally the result of a concentrated local violence, and are consequently found chiefly in the vault, and are mostly compound (Fig. 65).

In some cases of fracture of the vault, the bone will be depressed or driven in upon the cranial contents; in rare instances it will be elevated, ploughed up, or displaced outwards; a common result in sabre wounds. Depression.

The fracture will be confined in some to the outer table of the skull, in rare instances to the inner; a fracture, with depression of the inner table, occasionally existing without any fracture of the outer. In Guy's Museum there is a specimen of fractured skull in which the outer and inner tables are both fractured, but not in corresponding parts.

The direction of the fracturing force has much to do with the form of fracture. When applied from without and with sufficient violence to involve the whole thickness of the bone, the inner table, as a rule, will be fractured to a greater extent than the outer. When the force acts from within, the reverse holds good. This latter fact is best seen in gunshot fractures; and in Guy's Museum, Prep. 1082[70], taken from a patient of Mr. Poland's, the point is admirably illustrated. The external table is starred, but no fracture of the internal exists; the injury to the bone having been produced by a bullet which had passed through the opposite side of the skull and struck the inner table.

Fig. 65.



Comminuted fracture of skull, with depression of inner table from direct local violence. (Prep. Guy's Mus.

As points of practice, however, it is well to remember that, in all ordinary cases of fracture, with depression of the bones of the skull, the injury to the inner table is far greater than to the outer, and the point of exit of any foreign body through the skull is always larger than that of entrance. Rule in practice.

Whether depression of the bones of the skull of an adult ever occurs without a fracture, is an open question. There is certainly no good evidence in support of the fact. In children it has happened without giving rise to any symptoms of brain compression; yet even here, says Mr. Hewett, "some of the bony fibres must have given way." In these cases, the depressed bone may subsequently rise up again to its natural level. Depression without fracture.

The practical interest, however, attached to all these varieties of fracture is concentrated in the question as to how far the cranial contents are involved in the injury. Has the brain been slightly concussed, or so shaken as to have been bruised or lacerated? Have the membranes of the brain been torn, lacerated, or injured? Is the fractured bone a source of irritation to the dura mater? A compound fracture with or without depression, not complicated with brain disturbance or brain injury, is a cause of far less anxiety than a simple fracture in which severe brain concussion has taken place, and is indicated by symptoms; a severe shaking of the brain, whether complicated or not with a fracture, being a far more serious accident than any local injury to the skull. Brain complications.

Fractured base, &c.

Fractures of the base of the skull, or vault and base combined—for these conditions ought to be considered together—are invariably severe injuries. They are generally, except when produced by a crushing of the head, caused by a diffused force, such as that occasioned by a fall from a height upon the vertex, or by a heavy blow. "When the former the plunge of the body is suddenly arrested by the vertex coming in contact with the ground, and the entire superincumbent weight, with the superadded momentum acquired by the velocity of the fall, is concentrated around the condyles of the occipital bone, and the central compartment of the base of the skull is thus broken across." (Fig. 66.) The fracture is the result of direct violence, and not of so-called contre-coup.

The result of direct violence.

Le Gros Clark's explanation.

"Thus, if the injury be inflicted by the fall of a *hard* and heavy body on the vertex, this part would be fractured; and if the weight were not very great, the mischief might end there, as the resistance offered by the head may so far exhaust the momentum of the falling body that the force would not be transmitted in sufficient amount to cause fracture of the base. But if the weight and momentum of the falling body were in excess of the expenditure of force in causing fracture of the vertex, the impulse would drive the head down upon the summit of the spinal column, and fracture of the base would result; in that case, viewed mechanically, the lower fracture would be successive to the upper. But if the falling weight which struck the vertex were of a yielding material, fracture, if any, would be in the base, and not of the vertex, because the *vis inertiæ* of the skull would be overcome, and it would be driven down upon the spine, without the application of

FIG. 66.



Fracture of base of skull from fall on vertex.

circumscribed force to the vault. The same reasoning applies when fracture of either the vault or base, or of both together, is the effect of a fall on the vertex; or this result may be varied by the blow being received on the forehead or occiput; the anterior or posterior divisions being thin, and severally more obnoxious to fracture" (F. Le Gros Clark).

Injuries to the occiput are commonly followed by longitudinal fracture of the base, involviug both the posterior and middle fossæ. Variety of fracture determined by site of the blow.

Injuries to the temporal region or about the ear are followed by fracture of the petrous bone and the middle fossa; they are always serious.

But it is rare in diffused injuries to the head to fiud oue fossa alone involved, fissures generally passing through two fossæ, extendiug from the vault or part struck.

The evidence afforded by my notes of two hundred cases of fatal head iujuries clearly establish these poiuts which have also been experimentally proved by Dr. Arau.

"In precipitating a large number of bodies from various heights on to the head, Dr. Arau fouud that the part of the vault which first struck the ground gave, as it were, the key to the fracture which would take place at the base. Similar results were also obtaiued when diffused blows were dealt upon different parts of the skull by means of a large and heavy hammer. In the front part of the vault injuries thus produced led to a fracture of the auterior fossa; in the middle part of the vault they led to a fracture of the middle fossa; aud at the back of the head to a fracture of the posterior fossa. Iu no single instauce was a fracture detected at the base without a liue of fracture in the corresponding part of the vault. The truth of this has been proved by au aualysis which I made of all the cases of fractured base of the skull admitted iuto St. George's Hospital during a period of ten years." (Prescott Hewett.) Dr. Arau's experiments.

My own observations go entirely to prove the correctness of these views. The middle fossa is the oue, however, most frequeutly involved.

Compound fractures of the skull are, as a rule, local fractures. They are generally the result of a concentrated blow upon the part, the force employed having beeu expended in producing the local injury. They are, consequently, often starred or comminuted aud depressed fractures. When the brain is involved iu the injury, it is chiefly beneath the seat of fracture; it is rarely shaken or concussed as much as it is in simple fractures the result of a diffused blow.

The daugers attending a compound fracture do not, therefore, arise so much from the direct injury to the brain as from secondary intracraniul inflammation, the direct result of irritation of the dura mater by the depressed or comminuted boue; the dura mater being frequeutly punctured or torn by the depressed bone, and iu all cases irritated. These facts have an important bearing on practice, encouraging the surgeon to remove the depressed and irritating portions of boue which have such an injurious influence on the progress of the case. When the brain is injured by the accident, the danger is far greater. Compound fracture often followed by secondary brain inflammation.

THE DIAGNOSIS OF FRACTURE OF THE SKULL.

The best guide to the diagnosis of a fracture of the skull is, doubtless, the nature of the injury. There are no special symptoms by which a fissure of the vault, uncomplicated with a wound, can be recognised. Extensive fractures of this kiud are constantly found upon the post-mortem table where no suspicion of their presence was entertained during life. When a wouud complicates the case, a fracture can usually be made out, as the broken part

appears as a red line. Care, however, should be taken in these cases not to mistake a suture for a fracture.

Fracture with depression.

When fracture exists with depressed bone, the diagnosis is rarely difficult, unless it should so happen that the fracture has taken place beneath the body of the temporal muscle, when it is almost impossible to diagnose its existence by direct signs.

Sources of error.

An effusion of blood beneath the pericranium may be mistaken, unless care be observed, for a fracture with depressed bone; as may a natural depression in the skull, particularly in the occipital region.

Punctured fracture.

Fracture of the skull, the result of a punctured wound, can, as a rule, be readily recognised, but when the point of the perforating instrument has been broken short off at the surface of the bone, much care is needed.

Fracture of base.

The diagnosis of a fracture of the base, or of the base and vault combined, is always a source of difficulty. The nature of the accident is, without doubt, the surgeon's best guide; a fall from a height upon the head, or a heavy blow, is the usual cause of such an accident, though a crushing force applied in any direction may produce the same result.

Through middle fossa.

Should the fall have been upon or the force applied to the vertex, the middle fossa of the skull will probably be the seat of injury; and the diagnosis of a fracture through the petrous bone may with some confidence be made when such an injury is followed by profuse or persistent hæmorrhage from the ear, succeeded by the copious discharge of a watery and perhaps saccharine or slightly albuminous fluid, and paralysis of the parts supplied by the facial nerve. Slight hæmorrhage from the ear is no positive sign, the moderate discharge also of a watery fluid alone is not characteristic, nor is facial paralysis. But profuse and prolonged bleeding from the ear, or slight hœmorrhage, followed by a watery discharge, is, however, strongly indicative of a fracture; as is also a copious watery discharge directly following the injury. Facial paralysis, however, combined with either of these symptoms, renders the diagnosis complete. This watery discharge is now generally admitted to be an escape of cerebro-spinal fluid through a fracture of the petrous bone, passing across the internal auditory canal, and attended with rupture of the membrana tympani. I have known this to continue for eight days.

Bleeding from ears.

Facial paralysis.

Watery fluid from ear.

In injuries to the mastoid process, if a local emphysema exists, the presence of a fracture may be diagnosed.

Fracture of the anterior fossa.

Should the blow or fall have been upon the anterior part of the skull, the probabilities of the case point to fracture of the anterior fossa; and where any injury to any of the nerves of the orbit can be made out, as indicated by local paralysis of some of the muscles of the eye, or when hæmorrhage has taken place beneath the conjunctiva, the diagnosis is certain. Hæmorrhage into the eyelids by itself is of no value as a diagnostic sign, although when it follows the accident at a later period and is consecutive to subconjunctival hæmorrhage, it is a symptom of some importance.

Falls upon the occiput commonly produce longitudinal fissures of the base.

Bleeding from nose.

Copious and obstinate bleeding from the nose or pharynx is by no means unfrequent in a case of fractured base, and when accompanied with other suspicious symptoms is of diagnostic value. I have the

notes of a case of injury to the head in which the patient apparently died from bleeding from the nose and mouth, no blood coming from the ear; and, after death, a fracture of the base was found, completely separating the petrous portion of the temporal bone from its connections, and laying open the lateral sinus. The right tympanum was full of blood, but the membrana tympani was entire. The stomach was full of blood, the blood from the lateral sinus having apparently found its way through the Eustachian tube into the pharynx and stomach. Laceration of lateral sinus.

I have also the particulars of a second case, in which the carotid artery was divided in its passage through the petrous bone, and the lateral sinus laid open, the lungs and bronchial tubes being found filled with blood, even down to the air-cells. Each of these lived only two hours after the accident. Laceration of internal carotid.

Fracture of the base, unassociated with any injury to the brain itself, is of no more consequence than fracture of another part; but as the base is the most delicate part of the brain, and any injury to it is sure to be followed by severe, if not fatal, symptoms, the subject of fracture of the bones upon which it rests becomes of proportionally greater interest.

This fracture of the base may be associated with all the intracephalic injuries to which fractures of the vault are liable. It may be complicated with simple concussion of the brain, or with the more severe form associated with laceration of the brain-structure, or extravasation of blood upon or within the brain itself. If blood is effused there may be compression of the brain followed by death, or the same result may be produced by a secondary inflammation of the membranes and injured parts. Generally attended with brain injury.

It is difficult upon the whole to separate the two classes of cases, inasmuch as the dangers arising from injuries to the skull do not depend upon the seat of fracture but upon the injuries to the cranial contents; and, as the same injuries may be produced by, or rather may be associated with, fractures of the base, the complications and dangers are the same in each.

Having, then, so far shown that the dangers of all forms of fracture of the skull are really alike, and that the same intracephalic complications attend fractures whether the vault or of the base, I now proceed to illustrate the special symptoms generally regarded as being diagnostic of such injuries, by a brief analysis of cases from my notebook.

Among thirty examples which are there recorded, twelve were associated with simple concussion, in all of which recovery took place. In three cases the fractures extended through the orbit as indicated by subconjunctival ecchymosis. In eight there was hæmorrhage from the ears; in all, this was followed by a discharge of serum, and in seven of the cases it was associated with paralysis of the facial nerve upon the same side. In these it is quite fair to conclude that the line of fracture extended through the petrous portion of the temporal bone. In two there was bleeding from the nose; in one there was a serous discharge from the ear, accompanied by paralysis of the facial; in another this discharge followed hæmorrhage from the ear, and was unaccompanied by paralysis. *a.* Analysis of cases as illustrating special symptoms in injury.

To test the value of these different symptoms as indicating fracture of the base in various positions, the following analysis of the fatal cases

b. Fatal cases.

will prove of value; and, taking the symptoms separately, subconjunctival hæmorrhage will first claim our attention, as being one which more or less accurately marks a fracture through the orbital plate. In the eighteen fatal examples, this symptom was manifested in four instances; the line of fracture extending in each of these through the orbit.

In two cases there was copious hæmorrhage from the ear, while in both the fracture passed through the petrous bone.

In three examples there was some epistaxis; in one of these the fracture extended across the ethmoid bone; in another the frontal sinuses were full of blood and fractured; and in the third the tympanum was found full of blood, the membrana tympani perfect, and, upon careful examination, the lateral sinus of the brain was found to have been lacerated.

Injury of brain.

Seven of the eighteen fatal cases died from direct injury to the brain, the post-mortem examination in all revealing severe contusion or laceration of the brain-structure, with effusion of blood upon the surface of the brain or upon the membranes.

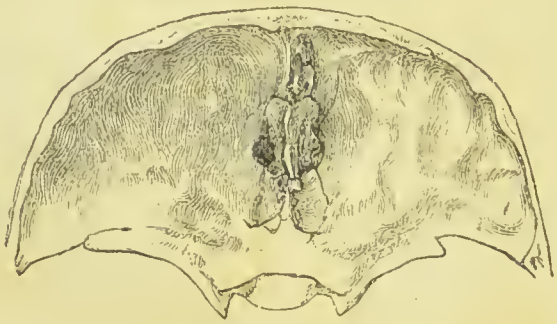
Arachnitis.

Seven other cases died from arachnitis as a result of the injury. In four of these there was contusion of the brain, and in one ecchymosis of the ventricles; in two there was no evidence of contused brain, nor was there any effusion of blood; in one interesting case the inflammation spread from the internal ear. In three, the cerebral mischief was complicated with some thoracic or abdominal injury, which caused death; and in one hæmorrhage was the immediate cause of death.

Rare cases.

A severe blow upon the nose, by driving in the ethmoid bone, may cause fracture of the anterior fossa of the base of the skull (*Vide* Fig. 67); and I have had under my care a case in which a severe blow upon the jaw produced a fracture of the middle fossa. At St. George's Hospital

Fig. 67.



Fracture of anterior fossa of the base of skull.
(Prep. No. 1085[87], Guy's Hosp. Mus.)

there is a specimen, in which a fracture of the base was caused by the condyle of the lower jaw being driven against the glenoid fossa with such force that the condyle projected into the cavity of the skull; and in Guy's Hospital Museum there is a similar specimen, which was sent in with Mr. Hutchinson's prize essay. Punctured wounds of the orbit are by no means infrequent causes of fracture

of the base; many are recorded. I was once called to a case in which a lead pencil had perforated the bone and the brain through the orbital

Fig. 68.



a. Punctured wound through frontal bone.
b. Portion of wood which perforated bone.
(Prep. No. 1086[60], Guy's Hosp. Mus.)

plate; and Fig. 68 was taken from a preparation in which the frontal bone was perforated. The diagnosis of these cases is not difficult. When brain-matter escapes externally through the wound there is no room for doubt.

The treatment of fractures of the skull will be described after the subjects of injuries to the brain and extravasation of blood within the cranial cavity have been considered.

CONCUSSION OF THE BRAIN AND ITS EFFECTS.

"A man receives a blow on the head, by which he is only stunned for a longer or a shorter period. What is said to have happened? Concussion of the brain. Ordinary acceptation of term.

"A man dies instantaneously, or lingers some time perfectly unconscious, after an injury of the head; there are no marks of external violence. Again, what is said to have happened? Concussion of the brain.

"The head is opened, and what is found? In one case no deviation from the healthy structure; in another, simply great congestion of the cerebral vessels; in another, numerous points of extravasated blood scattered through the brain substance; in another, a bruised appearance in some parts of this organ. In all, the case, in common parlance, is said to have been one of concussion of the brain. Such are the after-death appearances ascribed by different surgeons to concussion of the brain."

These words of an eminent surgeon (P. Hewett) so accurately describe the ordinary teaching of the schools, that I have transcribed them as a fitting introduction to the subject of which I am about to treat; not that they are strictly in accordance with pathological facts, for the expe-

rienee of the post-mortem room shows that in all eases of death from coneussion of the brain, some changes in structure are to be found if earefully looked for, some bruising or laceration of the brain, some bleeding into its substance. In fact, death from concussion of the brain without change of structure does not take place—*concussion and contusion of the brain being always associated in fatal cases.* At Guy's Hospital, duriug fifteen years, no case is reeorded of death from eoneussion without change of brain-struetnre.

"In every ease," remarks Mr. Hewett, "in whieh I have seen death oeeur shortly after, and in consequence of, an iujury to the head, I have invariably found ample evidenee of the damage done to the cranial contents."

Concussion and contusion of brain identical.

Mr. Le Gros Clark, of St. Thomas's Hospital, states—"I have never made nor witnessed a post-mortem after speedy death from a blow on the head, where there was not palpable physical lesion of the brain;" and Dr. Neudorfer, of the Austrian army, declares that he has never seen eoncussion, properly so called, except in apparently trivial iujuries.

M. Fano, a recent French writer, has also come to the conclusion "that the symptoms generally attributed to concussiou are due, not to the concussion itself, but to contusion of the brain or to extravasation of blood. In fact, all now agree that when death follows a severe shaking or concussion of the brain, eontusion or bruising of the brain is invariably found.

How far these views are correct in cases of concussion that are not fatal, is an open question; but in the few cases of concussion recorded in which death has followed from other causes, some injury to the brain substance has always been found; and, in all instances in which a fatal result has taken place from secondary inflammation, evidence of some bruising of the brain has been detected. A bruising of the brain, however, with a slight extravasation of blood, may be recovered from; although with exteusive effusion, compressiou of the brain aud death are the usual result. When it is generally accepted as true that concussion aud contusion of the brain are synonymous, the principles of the treatment of such injuries will be better appreciated.

In the simplest form of concussion of a healthy brain a slight and transient loss of power and consciousness is the only symptom. In the more severe form when a blow or injury produces some severe shaking of the cranial contents, this shaking is followed by a loss of consciousness more or less complete, and a loss of all power of motion; the skin of the patient will be cold, the features more or less contracted, the pulse slow and intermittent, and the pupils very variable—in some cases dilated, in others contracted, while in a third one pupil will be dilated and the other contracted.

If the case be neither one of great severity nor complicated with any grave injury to the cranial contents, after a variable period the patient will show signs of movement; and may, perhaps, move a limb in an impatient aud purposeless manner. If he is spoken to in a loud voice, he will, perhaps, show some signs of returning consciousness, either by making some inarticulate noise or by merely opening his eyes and afterwards returning to his stolid condition.

If the case be still carefully observed, the mode of respiration may be seen to be altered; and from being slow and laboured, it will be irregular, and perhaps sighing. After a time, if recovery is to take place,

other signs of what are termed *reaction* will make their appearance. The skin will become warmer and more natural, the shrunken and contracted features return to their normal condition, the pulse be more regular and rapid, and moreover vomiting may occur. The appearance of this symptom being generally of moment, and the first result of a more active circulation through the cerebral centres. As the case proceeds and all goes well, the patient rapidly recovers and returns to his natural condition, feeling, perhaps, somewhat heavy and dull for a few days, and indisposed for any bodily and much less for mental, labour. But if, on the other hand, the case goes wrong, the symptoms may either persist or pass into those of compression—complete insensibility, coma, and death; or, the symptoms of reaction may become excessive and run into those of inflammation of the brain or its membranes. Reaction after concussion.

In this brief sketch of an ordinary example of concussion or shaking of the brain the symptoms described are of a typical kind, and have been purposely dissociated from those of such complications as are liable to occur either primarily or after the period of reaction has taken place.

What change of structure is present in such an injury is, of course, an open question. In the simplest case the local injury must be slight; in the more severe, there is every probability that some bruising of the brain has been produced, while in the worst, laceration of the brain and extravasation of blood will probably have taken place, Effects of concussion on the brain.

In what is called concussion of the brain epistaxis is very frequent, and hæmorrhage into the lids of both eyes is not uncommon, though beneath the conjunctiva it is very rarely met with. Hæmorrhage from the ear directly after the accident is occasionally seen, and I have known it continue for several hours, the extravasation of blood, however, taking place in all these cases as a direct result of the accident. Epistaxis. Hæmorrhage from ear.

Again, in certain cases, a patient, having regained his consciousness, relapses into insusibility—*relapsing unconsciousness*—from which he may recover as perfectly as if no relapse had taken place. It would appear as if this condition were produced by the earliest effects of reaction, the vessels yielding too freely to the heart's pulsations, and thus producing a plethora of the part, which induces a comatose or semi-comatose condition. The following case illustrates these points. Relapsing unconsciousness.

A boy, æt. 11, having received a blow upon the head from a falling piece of timber, became perfectly unconscious and quiescent. He remained in this state for fifteen minutes, but recovering, he walked home some short distance. He soon began to feel sick and vomited, the vomiting being attended with *epistaxis*. He was then brought to Guy's, with a cold skin and labouring pulse. He was very slightly conscious and unable to answer any questions, while his limbs remained in the position in which they were placed. The pupils were dilated, but active. He was left in bed with the head raised, and a cold lotion applied to it. Warmth was also applied to the feet. He gradually recovered, and left the hospital in ten days convalescent. Case of relapsing unconsciousness with epistaxis.

The epistaxis and relapsing unconsciousness in this case, coming together at the time of reaction, point clearly to the cause.

Again, in children, reaction is not unfrequently attended with convulsions, which generally, however, pass away, and leave no mark behind. Should they appear in an adult, they are symptoms which cause anxiety, as they almost always indicate brain injury and forbode mischief. Reaction with convulsions.

Excessive reaction.

When reaction is excessive it is attended with symptoms of fever, and brain disturbance, such as delirium, excitement, and coma; but the subject of intracranial inflammation will claim attention in another page.

Extravasation of Blood as result of Concussion.

Effects of violent shaking of brain.

Bruising by contre-coup.

If the brain be violently shaken, bruising of its substance and extravasation of blood must ensue. When the injury is the result of a direct blow, the brain mischief may be only local, yet it is more usual to find the opposite side of the brain also bruised, by what is rightly termed "contre-coup," and it very often happens that the mischief to the brain by contre-coup is greater than that at the seat of local injury. When the fall is upon the vertex, the base is bruised; when on the occiput, the anterior lobe; when on the right parietal region, the base of the left middle lobe is the injured part; in fact, the base of the brain is almost always the seat of injury. In all these cases, blood will be extravasated to a greater or less degree; and when the vessels are diseased the hæmorrhage may be excessive. When the extravasation of blood is upon the surface of the brain it will be either upon or within the membranes, within the cavity of the arachnoid or the meshes of the pia mater, and under both circumstances the blood will gravitate to the base. When the extravasation of blood takes place into the structure of the brain itself it may be found in any part of the cerebrum, cerebellum or pons Varolii, or into the ventricles, the extravasation rarely showing itself in the form of one large clot, but commonly in small and numerous spots of extravasation.

Hæmorrhage on brain.

Diseased vessels.

Hæmorrhage into brain.

Results of post-mortem.

On referring to my notes on this subject, I find in a case of concussion, which proved fatal sixty hours after the injury, that the brain was bruised all over, and blood effused at the injured spots; the fluid in the ventricles was blood-stained, and the ventricles themselves ecchymosed. In another case of death from concussion, the result of a fall, in a man æt. 31, in whom convulsions and coma supervened on the fifteenth day after the injury, a layer of blood was found universally diffused over both hemispheres, dipping between the convolutions and passing downwards towards the base. The clot, which was shreddy, of a dull, reddish-black colour, had evidently been effused for some days. The surface of the brain beneath the seat of injury was softened, and at the base, where it had been injured by *contre-coup*, similar changes had taken place. The vessels were healthy. In a third case, where the vessels were diseased and death followed from concussion, multiple extravasations were detected after death throughout the substance of the brain.

In all these typical cases, illustrating the different effects of concussion, fatal results took place from severe shaking of the brain, unassociated with fracture; but it is to be remembered that where a fracture is present, unless it be attended with depressed bone, the shaking of the brain is the source of danger.

Diagnosis of contusion.

Severity and persistency of symptoms.

From what has been thus stated the conclusion may be drawn that the nature of the accident is the best guide in forming an opinion on the existence of contusion of the brain as well as on its extent; although the severity of the symptoms, or their persistency, is, doubtless, a valuable indication. The French surgeons, however, look upon the following symptoms as diagnostic of a contused brain:—"Tonic

spasms of the limbs; intense restlessness, with constant rolling and tossing about in bed; unconsciousness, more or less complete; drowsiness, without any stertorous breathing, and in the slighter cases simply contraction of one pupil or of one eyelid; spasmodic movements about some one muscle or another of the face or lips, giving rise to a difficulty of pronunciation" (Hewett). Mr. Le Gros Clark lays stress upon the following:—"More or less constant restlessness, accompanied by spasm, in which some particular member is affected, or amounting to general convulsion. If capable of giving expression to his feelings, the patient will point to some particular part of the head as the seat of pain. In some instances noisy incoherency and obtuseness of intellect accompany this condition from the first;" and these symptoms are doubtless enough to point to contusion of the brain. When they appear rapidly after the accident, they may be accepted as reliable; but when they come on a few days later they are as likely to be due to secondary inflammation of the brain as to contusion. Nevertheless, they may be regarded as valuable diagnostic indications of a bruised brain until better can be adduced.

Le Gros Clark's diagnostic marks.

The diagnosis of primary concussion and contusion of the brain, however, is almost impossible. The symptoms are so intermixed that the real nature of the lesion is not apparent. "The symptoms of concussion may be continued or renewed either by extravasation of blood, pus or both" (John Hunter, MS., 1787). The signs attributed to concussion, such as loss of consciousness, collapse, small, scarcely perceptible pulse and lowered temperature, are met with in other affections of the brain, and merely indicate that the functions of that organ, and their influence on the system at large, are in a state of abeyance. It can, therefore, only be declared that the brain was contused in the first instance, *if the symptoms continue*.

Diagnosis of primary contusion and concussion.

The seat of injury to the brain may likewise often be indicated by some paralysis, partial or complete, of one or more of the cerebral nerves. This paralysis may be either a passing or a permanent symptom. Paralysis of the seventh pair including the facial nerve, has been already alluded to as a somewhat typical symptom of fracture through the petrous portion of the temporal bone. This may appear as an immediate result of the injury, indicating laceration of the brain by the fracture; or, what is more usual, at a later date, when it may be the effect of pressure by effused blood upon the nerve trunk in some part of its course; or, at a still later period, by inflammatory effusion.

Seat of injury indicated by paralysis.

On referring to my own notes of cases admitted into Guy's Hospital at different periods during the last twenty years, I find examples of injury to the optic nerves, as indicated by blindness; paralysis of the muscles of the globe of the eye as a whole; and paralysis of the external rectus muscle alone. Paralysis of the facial and auditory nerves is very frequent, and at times there is paralysis of the fifth nerve, as indicated by complete loss of sensation of the face, &c. Paralysis of the hypoglossal has also been observed. In the majority of these cases the symptoms appeared as a direct result of the injury; in some they came on two or three days later, associated with febrile symptoms; but in most they disappeared in the course of a few weeks. In some instances, however, of facial paralysis the symptoms were permanent. In all these there must have been injury to the base of the brain. "The coexistence of hemiplegia on one side,

Injury to the cerebral nerves, &c.

with paralysis of the third nerve of the opposite side is indicative of lesion of the crus cerebri on the side on which the third nerve is paralysed." (Le Gros Clark.)

Aphasia after injury.

I had once under my care a man who received a severe blow on the left side of the head above the ear. The injury was followed by symptoms of concussion, which soon passed away; but he had complete aphasia. In the course of a few days he partially recovered the ability to speak, but then so thickly that he was unintelligible; in about three weeks he could be understood, but he did not recover his natural powers of speech for at least three months. During the greater part of this time he was subject to headache, which the least exercise or excess in diet made worse. There can be little doubt that in this case the base of the middle lobe of the right side had been contused. Mr. Callender tells us "that symptoms of aphasia are more apt to follow injury of a part of the left hemisphere outside the corpus striatum than any other part; that injuries to the right hemisphere are more rapidly fatal than are equal injuries to the left; and that the right-side brain lesions are more often associated with convulsions than are similar hurts at the opposite side." ('Brit. Med. Journ.,' June 6th, 1874.)

Remote effects of Concussion.

Remote effects of concussion.

There are, however, many injuries to the head which, without producing any definite symptoms, such as have been described as the result of concussion, &c., yet cause serious and often permanent damage to the patient.

The effects of a blow on the head are by no means determined by the immediate symptoms resulting, for it has often happened that a person has received a trifling injury, from which he is supposed to have completely recovered, while the case has ended in a permanent enfeeblement of the mental powers. It behoves the surgeon, therefore, to be most cautious in giving an opinion as to the issue of a case of injury to the head. As his functions seldom extend beyond the early period of treatment it is not necessary here to enter much into detail in such cases after pointing the moral that attaches to them all.

Insanity.

The records of lunatic asylums prove, unhappily, that many cases of apparently trivial injury to the head, unaccompanied by symptoms which would indicate any positive affection, such as concussion, paralysis, &c., have ended in an affection of the brain which has rendered the patient hopelessly demented, and, moreover, has left no visible traces of the malady in the brain after death. The following may suffice as illustrations.

A boy, æt. 16, fell from a tree and was found partly insensible. After a few days' treatment he was dismissed from the hospital as "cured." In a few months he was obliged to be placed in a lunatic asylum, where he remained several years.

A gentleman put his head out of the window of a carriage while travelling by railway, and received a scalp wound from striking against a post. He was rendered insensible at the time, but soon improved. There were no signs of importance, yet in a few weeks he was in a state of mental aberration and died in a year.

A man was kicked by a horse in the stomach and fell, striking his head on the stable floor, but had no cerebral symptoms. In a few weeks

he got delirious and confused in mind, and became in time hopelessly insane.

Such instances might be multiplied endlessly, all pointing to the supreme importance of injuries to the head, however slight the immediate symptoms. The reader may find this subject well discussed and illustrated by Dr. J. C. Browne in the first volume of the 'West Riding Asylum Reports,' in Abercrombie's works, and elsewhere. It may be laid down as a principle that persons with any hereditary predisposition to insanity or nervous disease are more liable to suffer from cranial injuries than others; whilst the temperate have a better chance of escape than those addicted to excesses of any sort.

Dr. J. C. Browne says in the report already alluded to, "We are justified in concluding that concussion may exert its worst influence without any organic change which is capable of being detected. Everything points to the conclusion that the evil of concussion really consists in what may be called dynamical changes in the nerve-cells and their connecting fibrils."

INJURIES OF THE BRAIN AND ITS MEMBRANES COMPLICATING FRACTURE.

When the student has recognised the fact that a blow upon the head, *not* complicated with fracture, is capable of producing, by concussion of the brain, injuries such as have been sketched in the previous pages, he will be quite ready to understand that a blow upon the head *complicated* with fracture is likely to be followed by results that are at least equally severe. He must know that, as the force required to produce a fracture of the skull is either more violent or more concentrated than that required to produce what has been described as a concussion of the brain, so there are other complications which are frequently associated with or are peculiar to fracture, such as depression of bone producing compression of the brain, extravasation of blood external to the dura mater from rupture of the middle meningeal artery, injury to the dura mater or membranes, and direct injury to the brain. He must also be aware of the fact that a fracture of the skull may take place without producing any cerebral disturbance; for example—

Fracture without brain complication.

A man, æt. 27, received a blow over the vertex from a broken sword. An extensive scalp wound was the result, and a very evident incised wound in the upper portion of the frontal bone, apparently involving only the external table. It was not complicated with the slightest cerebral disturbance, and good recovery followed.

Incised wound of the skull.

A boy received a compound fracture over the frontal region from the kick of a horse; he had no head symptoms whatever, and recovered.

Compound fracture of frontal bone without brain injury.

In the former case there was an incised wound of the skull, and in the latter an undepressed compound fracture. In neither was the brain shaken, bruised, or otherwise injured, and in both a good recovery ensued. Cases such as these, however, are comparatively rare; the more frequent being examples of fractured skull associated with brain symptoms similar to those which have been described under the head of simple concussion; cases in which the functions of the brain are for a time more or less interfered with or suspended, but which have a tendency gradually to return to their normal condition; in which the injury to the skull has been severe enough to

Fracture of skull and concussion.

break the bone, and general enough to shake the brain and cause a suspension of its functions. The importance of these, however, lies in the injury the brain has sustained, and not upon the fracture; the fracture being only a complication, and so long as there is no depressed bone irritating and compressing the brain, the danger is in no way increased. If, however, in any given instance, the injury is complicated with laceration of one of the large arteries of the bone such as the middle meningeal artery, other conditions may arise which produce special symptoms.

Fractures of the skull associated with extravasation of blood between the dura mater and the bone.—As the result of an injury to the skull, whether with or without a fracture, small extravasations of blood between the dura mater and the bone are not unfrequent, and are due to the rupture of some of the small vessels which pass from the bone to the dura mater beneath. They give rise to no symptoms by which they can be recognised, and usually are only discovered after death.

Source of hæmorrhage middle meningeal artery.

When any large extravasation occurs, the blood comes, as a rule, from the trunk or from one of the branches of the middle meningeal artery, which runs upward in a groove of the anterior inferior angle of the parietal bone, and divides to supply the lateral parts of the base and vault of the cranium. A fissure, therefore, of the bone in these parts may lacerate one of these branches, and give rise to a hæmorrhage sufficiently copious to produce symptoms of compression of the brain.

It is well to know, however, that the brain will sustain a great deal of pressure without giving rise to any symptoms, and that several ounces of effused blood rapidly poured out are required to produce such

Torn venous sinus.

symptoms as are recognisable. In rare instances the hæmorrhage may come from one of the large venous sinuses which has been torn.

The following is an excellent case to illustrate the accident:

Case.—A man, æt. 49, when riding in a gig, was thrown out upon his head. The accident produced a scalp wound over the left side of the vertex and some slight insensibility. He got up and walked for half an hour, when he became confused, staggered, and went into a shop, being supposed by the shopkeeper to be intoxicated, but as he gradually became quite insensible he was brought to Guy's. When admitted he was perfectly unconscious and comatose, with dilated pupils, labouring pulse, and slow respiration. Soon afterwards he became convulsed, the right arm being more affected than any other part, which in a few hours, however, became paralysed. He remained in this condition for two days, and died comatose. After death, upon removing the calvaria, which was fissured in a vertical direction from the middle of the left parietal bone to the jugular foramen, a large clot of blood was seen lying upon the dura mater, clearly proceeding from the middle meningeal artery. This was about two and a half inches in diameter, and more than an inch in thickness. It formed a *globular tumour*, and caused an extensive depression upon the left cerebral hemisphere, which pressed the longitudinal fissure to the right side. The brain itself was healthy. Prep. 1606[50] in Guy's Hosp. Mus. shows the condition. In Fig. 69 these parts are well seen.

Interval of time between accident and effusion of blood.

Such a case may fairly be accepted as a typical example of this form of injury, and special attention should be paid to the fact, that the man recovered from the immediate effects or shock of the accident, remained sensible for a definite period, and then gradually became unconscious.

In compression from hæmorrhage this "interval of time," provided it be a short time, between the accident and the occurreuce of the sym-

Fig. 69.



Drawing showing clot (*b*) external to the dura mater (*c*) from laceration of the middle meningeal artery (*a*) following a fracture. (Drawing 80^{20}, from a case of Hilton's, G. H. M.)

ptoms is most important from a diagnostic point of view; it is very eommonly, althongh uot eonstautly, present; but, when present, it is eharaeteristie of hæmorrhage in somc form. The symptoms, to be those of compressiou must also be lasting; nor must they be mistaken for the "relapsing unconsciousness" of a shaken brain, to which attention has been already directed. The persisteney of the symptoms is consequently a valuable diagnostic symptom. Persisteney of symptoms

But it may be asked, how is extravasation of blood, the result of a lacerated meningeal artery and therefore outside the dura matcr, to be diagnoscd from extravasation of blood within thc eavity of the arachnoid, upou the surfaee of the brain, or within the brain itself? For nnder all these eircumstances the symptoms may appear some time after the aceident, the inference drawu from the "interval of time" being the same in each; nuder all, thc symptoms of eompressiou will be identieal, for they will be those of apoplexy, aud, as in apoplexy, varying in eaeh ease; for "when extravasation takes placc on the surface or within the substanee of the brain, it is aeeompanied, and, indeed, produeed by lesion of thc eerebral texturc, whieh lesion is mostly indieated by paralysis, by irritation or spasmodic aetion affeetiug some particular part, by derangement of the pupils, or by other symptoms." (Coek.) The surgeon's best guide, however, in forming his diagnosis will always be the history of the case, when it can be obtained, and also the nature of the aceident.

In uncomplieated eases of hæmorrhage *external to the dura mater* the injury is generally a loeal oue, produeed by a sharp blow or fall; thc brain, as a whole, is not shaken or injured; the symptoms of compression are, moreover, generally very marked aud rapidly produced, and the paralysis of half the body is also commonly eomplete. Blood external to dura mater.

In eases of hæmorrhage *into the arachnoid cavity, or upon the surface of the brain*, the injury is mostly of a gcucral character, such as a Blood internal to dura mater.

fall from a height or a blow from a heavy weight; the whole brain having been violently shaken or "concussed," and, as a result its delicate structure more particularly that of the base, has been bruised or lacerated, weak or diseased vessels being very apt to give way, producing hæmorrhage. Hæmorrhage external to the dura mater may, it is true, be present in these cases of general injury, but it will be complicated with extravasation into deeper parts; and this point of diagnosis is all important, since in the former class of cases, when the blood is between the bone and dura mater, surgical treatment may be of inestimable value, whilst in the latter it can be of no service.

Hæmorrhage on surface of brain after fracture with bruised brain.

Hæmorrhage upon the surface of the brain is a very important subject, occurring in variable degrees in every case of severe or general injury to the skull, whether complicated or not with fracture; the brain itself may be not only bruised at the seat of injury, but it will be equally, if not more, injured at the opposite point by *contre-coup;* and this bruising and extravasation is generally found at the base of the brain. The hæmorrhage associated with this bruising may be so slight as to give rise to no symptoms, and recovery may take place; or it may be so great as to induce symptoms of compression. But when a large vessel of the pia mater is ruptured, the bleeding will be severe, and under these circumstances the blood may spread into all the parts down to the base, covering in the cerebellum and spinal cord.

It is this fact that renders all cases of *general injury* to the brain so serious, and tells so powerfully against any operative interference in such a class of cases, the surgeon being quite unable to reach the source of compression by trephining.

Hæmorrhage into cavity of arachnoid after injury.

Hæmorrhage into the cavity of the arachnoid is by no means a common consequence of head injury, but it may occur as a result either of a local or direct injury to the skull, or of a diffused one; and the effused blood may be poured out upon one or both sides of the cerebrum. When the effusion is gradual and not extensive, no definite symptoms of compression will be produced; but when extensive, although symptoms of compression may appear, there will be nothing to indicate the precise position of the hæmorrhage.

Patients with kidney disease.

In patients who have albuminuria, or diseased arteries, there is reason to think that a slight injury to the head may cause extravasation of blood into the arachnoid, and this fact has an important practical bearing, furnishing a key to the solution of many a doubtful case of head injury.

Arachnoid cysts after hæmorrhage.

Pathology has taught us that blood clots may organise and form what are now known as arachnoid cysts, having smooth external surfaces like a serous membrane; which when recent, will be soft and pulpy; when old, fibrous. They may contain only serous fluid more or less blood-stained, or clots of blood altered by time. Sometimes these cysts are found to be loose in the arachnoid cavity, at others fixed to the parietal arachnoid. They are usually found *accidentally* after death in those who have suffered from mental disorder or general paralysis, and although more commonly they exist on one side of the head only, they are sometimes found on both.

Dr. Crichton Browne ('Journal of Psychological Medicine,' December, 1875) tells us that out of 1240 post-mortem examinations made at the West Riding Asylum, there were 59 examples of arachnoid cysts: 43 occurred in males, 16 in females, and the majority

were in the left side. In half the cases general paralysis was the cause of death. Dr. Browne does not think that these cysts have a traumatic origin, but are due to the rupture of a vessel from cerebral hyperæmia.

To Mr. Prescott Hewett ('Med.-Chir. Trans.,' vol. xxviii) must be assigned the credit of explaining how these cysts are formed from a chronic change in previously effused blood. For a full elucidation of the subject, however, we are indebted to Drs. Wilks, Ogle, Bacon, and Sutherland ('Journal of Mental Science,' vols. x and xi; 'Rep. West Riding Asylum,' vol. i).

COMPRESSION OF THE BRAIN.

Varieties.

The brain may be compressed in many ways; though there are four special causes of compression:—Compression from *depressed bone*, the result of fracture, simple or compound; compression from the *extravasation of blood* into any part of the cranium; compression from the *formation of matter* between the dura mater and the bone; and compression from the *effusion of inflammatory products* into the brain or its membranes.

Onset of symptoms in each variety.

The symptoms of compression under all these different circumstances are much alike, although the clinical history of the cases and the date of the appearance of the symptoms after the injury vary in each class. When the result of depressed bone, the symptoms are the immediate consequence of the accident. When caused by extravasation of blood, there is almost always some interval of time between the accident and the accession of the symptoms, although that interval may be but short. When caused by the effusion of inflammatory products into or on the brain, the symptoms generally appear some days after the accident, and are gradual; and, when the result of the formation of matter between the dura mater and the bone, the symptoms rarely show themselves for two or three weeks after the accident. In both of the latter classes of cases, moreover, headache and other inflammatory symptoms coexist.

Symptoms those of apoplexy.

The symptoms of compression of the brain are those of apoplexy, and their severity depends entirely upon the suddenness and amount of the compression. The skull may be fractured and the bone depressed, and still no symptoms arise. Extravasation of blood may also take place to a limited degree within the skull and not be recognised. There is good reason to believe, indeed, that a considerable amount of blood may be poured out *slowly* upon the surface of the brain without giving rise to compression, the brain gradually accommodating itself to the pressure. The most marked cases of compression are usually due to rapid extravasation. When the bones are much depressed, or when the brain is suddenly compressed by the local effusion of blood, symptoms show themselves, such as complete insensibility, slow, difficult, and perhaps stertorous respiration, and a full, slow, labouring pulse. The pupils may be either dilated or contracted, but they will be always fixed, and will not respond to light. In very severe cases the respiration will be of a peculiar *puffing* character. There may also be complete loss of the power of swallowing, inability to retain fæces, and retention of urine—incontinence or overflow of urine being the last symptom.

When the brain is widely and uniformly compressed by an effusion

of blood or in some other way, the symptoms are "general," *i. e.* one side is not more paralysed than the other. When the compression is more localised, the paralysis is partial and corresponds with the region affected; though when the extravasation is extensive, even though localised, the general effect may mask the local symptoms. The best examples of this form of limited compression are found in cases of fracture of the skull from a local injury, and extravasation of blood between the bone and the dura mater. The case quoted on page 216 is a good one in point; though the following is probably a better, as it is complete.

Hæmorrhage between bone and dura mater without fracture; trephining; recovery.

J. P—, æt. 46, a painter, having fallen from a height upon his head on a piece of iron, received a severe scalp wound on the right side of the median line of the head, with slight concussion. He was admitted into Guy's under Mr. Cock's care in 1841, conscious, and remained so for eleven hours after the injury; four hours later he was found in a state of utter unconsciousness, with stertorous breathing and insensible pupils. He continued gradually to get worse. The left arm and leg when pinched were readily retracted. The right side was completely paralysed. No fracture could be discovered. Trephining was performed above and behind the anterior inferior angle of the left parietal bone over the trunk of the middle meningeal artery, and a large piece of bone removed. A gush of blood then took place, and a large coagulum was removed from outside the dura mater. The deep stertor at once ceased, and the next day the man moved his right arm and leg freely, and recognised his wife. He progressed favorably after the operation, though recovery was retarded by bone exfoliation. He resumed his work and occupation, and continued in good health for thirteen years. During this period, however, he had at intervals exfoliation of some portion of the skull at the seat of injury; in the ninth year he had fits, which during the last six years of his life recurred at intervals, the attacks, as Mr. Cock reported, becoming gradually more frequent and severe in their character. Six months before his death he had paralysis of the opposite side of the body to that of the injury; the face was included in the paralysis, and his speech was somewhat affected. He died after a severe apoplectic fit. After death the brain beneath the injured bone was found softened and adherent to the skull; and it contained a recent clot of three or four ounces of blood, which filled the ventricles. "It appeared probable," says Dr. Wilks, who made the examination, "that a softening had been going on for some months in the middle hemisphere of the brain, involving the contiguous surfaces of the corpus striatum and thalamus, and that at last a rupture of the vessel had taken place, infiltrating all these diseased structures as well as the ventricles." The trephine opening was filled in by a tough membrane; and around its margins there was evidence of considerable ostitis having taken place. (Cock, 'Guy's Hosp. Reports,' 1857.)

a. Local injury and local paralysis.

When a patient receives a direct blow upon one side of the head, causing a fracture with depression of the bone, and attended with paralysis of the opposite side of the body and a fixed and dilated pupil on the side of the injury, the conclusion is inevitable, that the depressed bone is the cause of the paralysis, by producing pressure upon the brain; the depression must, however, be very great to give rise to such symptoms.

When a patient snstains a similar injury, with or without depression of the bone, bnt followed after a distinct interval of time by paralysis of one side of the body, whether of the injured side or not, it is qnite fair to assume that hæmorrhage has taken place inside the sknll, and is the cause of the compressiou.

In both these cases a local injury is followed by local mischief, causing a local paralysis, couseqnently surgical treatment is of great promise.

b. Effect of general concussion of brain, with or without fracture.

When a patient receives a general injnry to the head—snch as commonly resnlts from a fall upon the head from a height or a diffnsed blow from a heavy falling body—and this is followed directly or after an interval of time, by symptoms of compression, whether associated or not with a fracture, the paralysis is, as a rnle, geueral; and even if more complete on one side than another, the injnry to the brain is, for the most part, too diffused or extensive to admit of snrgical relief. The case is clearly of a mixed nature, contusion or laceration of braiu-strnctnre being associated with hæmorrhage.

Symptoms of brain injury.

When a patient snffering from brain shock with or without a fracture, is unconscious, motionless, and perhaps pnlseless; has lost control over the action of the bowels aud the bladder; and has a feeble respiration aud paralysed pupils, it is impossible for the snrgeon to form any opinion as to the nature of the cerebral injury; because these symptoms may be the resnlt of so-called concussion, from which recovery may take place, and not of severe brain contusion; they may be associated with bruising of the brain and extravasation of blood, not sufficient, perhaps, to cause fatal compression of the brain-structure, but enough to set up cerebral symptoms, which canuot pass away for mauy months under the most favorable conditions; or they may be accompanied by severe brain laceration or extravasation of blood upon or iuto its structure, which will prove fatal by coma. The position of the extravasation has no iufluence on the symptoms, although it would appear that death is very rapid when it takes place into the ventricles. The primary symptoms of severe concussion and of general compression are ideutical, and are often not to be distinguished; both may be the resnlt of the same kind of accident. "But," says Mr. Hewett, "there is this marked difference: iu coucussion the effects are instantaneous, and in compression from extravasated blood some little, it may be very short, time elapses before the symptoms manifest themselves. In the former, also, the symptoms gradually pass off, but in the latter they become more and more marked."

Diagnosis between concussion and compression.

"The diaguostic signs of concussion aud compression are, no doubt, distinct iu a certain sense, yet compressiou rarely exists as a consequence of violeuce without concussion, and both are complicated with shock. Further, symptoms of simple concussion may become developed, at a later period, iuto those which indicate some more serious lesion: and it is in exceptional cases only that we can identify, with any degree of certainty, the efficient and sole cause of compression. Thus, in the stunning effects which succeed a blow on the head, if we can rouse a patient from his state of uncousciousness, even for a few moments, if the breathing is calm and noiseless, if the pulse is feeble, the pupils are contracted and reflex action can be excited, we conclude that the condition is one of concussion. The intensity of the effects of so-called concussions are marked by the character of the symptoms and by their

duration. The probable explanation of protracted somnolence and other evidences of brain disturbance is the presence of diffused extravasation of blood over the surface of the hemispheres." (F. Le Gros Clark.)

Hæmorrhage into brain, with fracture.

Again, in a general shaking of the brain, blood may be extravasated into the brain itself, and when the injury has been sufficient to produce fracture there is no limit to the amount of hæmorrhage or its seat. "But in dealing with such cases, great caution is necessary in order to avoid, if possible, mixing up cases of apoplexy with those of traumatic effusions. An accident coexisting with an extravasation of blood into the cerebral substance does not necessarily imply cause and effect. The previous condition of the brain or the outpouring of blood from diseased vessels may, in fact, have been the cause of the accident." (Hewett.)

Cases.

On referring to my notes I see that in a case of brain injury which lived only one hour, blood was found filling the ventricles. In another the ventricles were bruised and the septum lucidum lacerated. In other cases blood was poured out into the thalamus opticus or into the corpus striatum.

In all these the brain had been severely shaken, the hæmorrhage being doubtless the result of the shake and the cause of death, while the fracture of the skull was merely a complication.

General summary.

It has been already shown that concussion of the brain too often implies contusion or laceration of its structure, with extravasation of blood, and, in the same way compression indicates as serious if not more severe injury. Concussion does not by itself produce definite symptoms, and when paralysis, vertigo, sickness, or other such phenomena, arise, the inference is that there is some structural damage to the brain. Compression implies a more severe degree of the same sort of injury with effusion of blood or depression of bone. Compression of the brain, when not excessive, is seldom the *direct* cause of death. It proves fatal in the majority of cases by being the starting-point of an intracranial inflammation; since it has been proved that blood can be absorbed or encysted, and depressed bone may be gradually raised by the brain itself, or, the brain may accommodate itself to the pressure.

Compression of the brain, as a result of traumatic encephalitis, will receive attention in a subsequent page.

Wounds of the Brain.

Escape of brain through wound. Prognosis.

In some injuries to the skull the brain may be wounded or lacerated, and brain-matter may even escape from the wound directly after the accident. Such accidents are always of a very grave nature, and, as a rule, fatal. Wounds of the anterior and upper portions of the hemispheres are the least dangerous; wounds of the posterior hemisphere or base of the brain the most so. Recovery may at times follow even after very severe injuries when no secondary inflammation takes place; but the prognosis must always be unfavorable.

When brain-matter is pressed out of the skull in cases of fractured base, a grave injury is always inflicted, for the crushing force must have been severe to have given rise to such a complication. Some remarkable

instances of recovery after the escape of brain-matter are, however, recorded; and several have passed under my own observation, but they are too rare to be dwelt upon as holding out any hope in bad cases. Foreign bodies may likewise lodge in the skull for a long period without causing death. Wounds of the brain are not characterised by any special symptoms apart from those of concussion or compression.

Wounds of dura mater.

Wounds of the dura mater are probably as dangerous as wounds of the brain, for inflammation of the membranes is readily set up by such injuries. It is from this fact that compound fractures of the skull are so serious; that simple fractures associated with comminution of the inner table of the skull are so often fatal; and that punctured fractures have so dangerous a tendency; for in all these cases the dura mater is not only torn, but irritated by the projecting spiculæ of bone, and secondary inflammation is the result, this inflammation, as a rule, rapidly spreading over the brain and causing death.

Prognosis.

Wounds of the dura mater, as well as wounds of the brain, are, however, recovered from, but the prognosis in either case must be unfavorable.

FIG. 70.



Hernia cerebri.

Hernia cerebri and its treatment.

Hernia cerebri, or protrusion of brain-matter alone or brain-matter mixed with inflammatory products, is always the result of a wound or slough of the dura mater, secondary either to a compound fracture or to the removal of fractured or diseased bone with the trephine. It is probably always associated with some suppuration (local) of the brain, due to extension of inflammatory mischief to that part in contact with the diseased dura mater and bone. It is to be treated with great caution. Some surgeons are in the habit of cutting off the projecting mass, others of applying pressure; but probably the best practice lies in doing very little, in keeping the parts clean and dry, and leaving their repair to natural processes;

because should the local affection be so limited in its nature as to be capable of repair, the projecting mass will slough naturally after a time, and cicatrisation will follow; but all interference on the part of the surgeon does harm. The best treatment is at first to apply a piece of lint to the part, and, at a later stage, to keep the hernia dry by dusting it with oxide of zinc or powdered alum. Excision and the application of caustics or pressure, do not appear to be satisfactory forms of treatment.

The experience of army surgeons during the American war confirms these observations.

INFLAMMATION OF THE CRANIAL BONES, BRAIN, AND MEMBRANES, THE RESULT OF AN INJURY TO THE HEAD.

In all cases of injury to the head, simple or severe—attended or unattended by fracture;—of concussion or compression;—of injury to the dura mater or the brain, inflammation of the bones, of the brain, or of its membranes, is very liable to arise, and when it does, it is a very grave complication. It is this fact which makes all injuries of the head, even simple contusions of the bone, sources of danger, because inflammation, commencing in the bone, too frequently spreads inwards to the membranes of the brain and to the brain itself, and thus destroys life. The free communication between the pericranium and the dura mater, by means of the blood-vessels of the diploë, is a probable explanation of this occurrence in simple scalp and bone contusions. In injuries to the bones of the skull, and to the brain or its membranes, the liability to encephalic inflammation appears to be greatly determined by the severity of the accident.

Encephalic inflammation.

In the present chapter, traumatic encephalitis, *acute* and *chronic*, as the result of brain shocks, whether with or without a fracture, will claim attention.

Symptoms of acute encephalitis.

In acute encephalitis the symptoms generally appear on the second or third day following the injury, pain in the head being the most prominent symptom. This pain may be local or diffused, and is generally accompanied with intolerance of light and contracted pupils, intolerance of sound, and symptoms of febrility. As the disease progresses, wakefulness, restlessness, delirium, and convulsions will probably follow; and the patient will pass more or less rapidly into a comatose condition owing to compression of the brain by effusion, when a speedy death will ensue. The effusion takes place sometimes into the ventricles, but more often on the surface or the base of the brain.

Symptoms of chronic encephalitis.

In chronic encephalitis the symptoms may show themselves soon after the injury, but, as a rule, they do not appear for weeks, or even for months. They are most insidious in their nature; they may begin by want of sleep, with an irritability of brain and inaptitude for any bodily exertion; but headache of a constant exhausting kind, aggravated by mental or physical exertion, is a most prominent symptom. As the disease progresses the patient gradually becomes emaciated and exhausted, and, towards the close of the case epileptiform convulsions, local paralysis and coma supervene.

. The *acute* cases, for the most part, are the result of a severe *general* shaking of the brain, with or without fracture, complicated with contusion or laceration of the brain-structure or its membranes, They are consequently cases of arachnitis and inflammation of the brain-substance itself, the inflammation of the membranes being general. "I have never known," says Wilks, "such an affection as arachnitis spring up as a spontaneous disease, and therefore when met with you should always look for some mischief without. When arising in this way, the interarachnoid effusion is often purulent, and so copious that it may pour out when the dura mater is removed. I have never seen extensive effusion into the interarachnoid space without an injury on the head."

Acute, result of general shaking of brain.

The *chronic* cases are, for the most part, the result of a *local* injury and begin in the bone, spreading inwards to the dura mater, and at last involving the arachnoid cavity with its two layers of serous membrane, the pia mater, and even the brain itself; local suppuration being frequently found in these cases, either between the bone and dura mater, or in the brain itself, from extension of inflammatory action from without inwards: the whole process in the majority of instances being a local one. The same changes may take place in all cases of chronic ostitis of the calvarium, whether from accident or disease.

Chronic, result of injury.

Suppuration in brain by extension of inflammation.

The acute or diffused form of arachnitis is the cause of death in most of the cases of head injury that survive the immediate results of the accident. It comes on in the stage of reaction, indeed, it may be looked upon as reaction in excess, febrile symptoms, convulsions or convulsive twitchings, delirium or mania more or less acute, terminating rapidly in paralysis, coma, and death, being the general sequence of symptoms. Effusion of serum takes place into the ventricles and upon the brain, causing at times compression; or effusion of pus or puriform lymph occurs either upon the brain itself, or in the meshes of the pia mater, or into the cavity of the arachnoid.

Common cause of death in head injuries.

Reaction in excess.

Whenever the brain has been severely shaken and consequently bruised or lacerated, inflammation may appear at the injured spots; hence it at times shows itself *beneath the seat of the blow*, but more frequently begins on the opposite side of the brain to the seat of injury, where the brain has been *bruised or lacerated by contre-coup*; from these centres inflammation may spread either to the membranes from the cortical structure of the brain, or to the substance of the brain itself; thus, in all cases of a general shaking of the brain, the seat of inflammation is in most cases at the base. The pia mater and cortical substance of the brain are commonly the seats of inflammation, but the cavity of the arachnoid is likewise involved in many cases secondarily by extension of the morbid action. There are no symptoms by which the precise seat of inflammation in the brain or its membranes can be made out; they are alike in all cases.

Seat of origin of inflammation.

No indications of seat of inflammation

It will thus be seen that the two classes of cases of acute and chronic encephalitis are distinct in a measure. The *acute* is the result of a bruising of the brain by a severe shaking or concussion, the bruising being, as a rule, at the base of the brain by contre-coup. The inflammation begins in the pia mater, spreads outwards, and is for the most part diffused and not local. Consequently it is *beyond* the reach of surgical operation.

The *chronic* is generally the result of a local contusion or fracture of the bone, and local in its action. It involves the dura mater by

extension from without, and the arachnoid, pia mater, and brain consecutively in the same way. It is consequently *within* the reach of surgical art, particularly in its early stage.

Treatment of encephalitis.

TREATMENT.—Acute encephalitis when following a general injury to the brain, for the most part runs such a rapid course that there is little time for treatment to take effect. It attacks patients, moreover, who have been already knocked down by the injury in more ways than one, in whom there is rarely much resisting force, and there is consequently not much chance of success by treatment.

Head shaved and raised.

Ice to head.

The head must, of course, be shaved and raised on a pillow, and ice should be applied to it, for there is no remedy more valuable than the application of ice in tranmatic inflammation of the head. The ice when applied in a bag must be broken up into small fragments, while the bag containing it should be large, in order to cover the whole vault of the skull. The ice-cap or india-rubber coil is also good. The cold douche

Free purging.

Enema.

is a powerful remedy and has been highly spoken of. Free purging should then be resorted to, the old dose of calomel mixed with butter introduced into the mouth being probably the best form; or an enema of turpentine or castor oil may be administered.

Bleeding.

With respect to bleeding, much caution is required. It has been little used of late years in head affections; though in a strong man, when acute encephalitis has come on after a slight injury, it is certainly a sound practice. It should be performed boldly and freely at the early part of the disease, so as to take effect upon the patient—during the state of excitement, before brain oppression has appeared, and effusion taken place. In severe general injuries it is useless. Some employ leeching and cupping on the nape of the neck, and speak highly of the practice.

Calomel.

Calomel, given in small and repeated doses to touch the gums, combined or not with opium, has its advocates, and patients, doubtless, have recovered under its use. The grey powder in three- or four-grain doses with five grains of Dover's powder, is a useful combination when delirium is present; and at times larger doses of opium or morphia may be given. Great care, however, must be observed in the use of these drugs, for unless they are carefully given and their effects watched, they are injurious.

Blisters.

French surgeons still employ blisters to the scalp, but these cannot be compared in value with the local application of ice in the early stage of the disease. In the chronic stage they may be beneficial. When they are employed they should be applied to the nape of the neck, and where mercury is relied upon, the latter may be used in the form of an ointment to dress the blister. Antimony is still given by some surgeons of eminence. I have no experience of its use, and therefore cannot recommend it. When recovery takes place—a rare result—the patient must be cautioned as to the future, for any excess of diet or of mental or physical exercise

Diet.

Rest.

may produce a relapse. The greatest quiet ought to be observed for many weeks, and the patient should live on the simplest food. Milk diet and animal broths are sufficient for some time, solid animal food being taken with great caution. Stimulants should only be administered if the patient's powers are feeble.

Compression of brain from local suppuration.

When indications of compression of the brain follow these inflammatory symptoms, surgical treatment may be called for, but only when strong evidence of local compression exists.

When the symptoms are the result of *acute* encephalitis, and, consequently, of a general injury or shaking of the brain, there is little doubt that its compression is due to the effusion of inflammatory fluid into, upon or beneath the brain, and under such circumstances the question of surgical interference should not be entertained. It is to be thought of only in cases of local *chronic* suppuration, when as has been already shown, the symptoms are the result of a local contusion of the bone, of injury, or disease, and the seat of suppuration is usually between the bone and the dura mater. At times, however, a local abscess is formed in the cavity of the arachnoid; and under the circumstances when strong evidence of this condition exists, the parietal layer may be punctured, good results having followed this practice.

Puncturing the brain for suppuration.

In more advanced cases, suppuration may even involve the brain itself; and it is a serious question whether a surgeon is ever justified in puncturing this organ with a view of laying open the suppurating cavity. Should, however, good evidence exist of suppuration in the cerebral hemisphere beneath the seat of injury, I have no doubt as to the surgeon being justified in making an exploratory puncture, for Mr. Holden has recorded in 'St. Bartholomew's Hosp. Rep.' for 1873, a case in which success followed this practice, and in the 'American Journ. of Med. Science' for July, 1873, five other successful instances may be referred to, but the evidence must indeed be strong to justify such a measure. Dupuytren had a successful case of the kind, and pathological anatomy furnishes examples in which such a practice might have been of use. On the other hand, many bold attempts are on record in which surgeons have punctured the brain to relieve symptoms of suspected suppuration in its substance. Weeds's case is without doubt the best, as it was successful ('Nashville Journ. Med.,' April, 1872), but Detmold's and Maisonneuve's are encouraging.

Still, in such cases much may be done—more, indeed, than is usually attempted—for the relief of symptoms, and I am disposed to think, that surgeons are too apt to leave these cases alone too long, and allow them to get beyond relief.

Symptoms of local ostitis after contusion of cranium.

A man receives a blow upon the head, followed by passing symptoms of so-called concussion; he has a slow convalescence, attended, and perhaps followed, by headache. He may display some irritability of brain, inability to do much work, or to undergo any physical fatigue; some febrile disturbance may perhaps manifest itself, but as often as not none appear. The pulse probably will be feeble and irritable, at other times slow and labouring. On examining the seat of injury, tenderness on pressure may be experienced, and occasionally increase of heat will be felt. Pressure upon the injured part may even excite a convulsion where such had previously occurred.

Under these circumstances, which are fairly indicative of local inflammation of the bone, spreading inwards—though how far is uncertain—a free incision to the bone is of great value. I have known this operation relieve immediately all the symptoms, general and local, and have never known it followed by harm. It should always be performed when evidence of local inflammation exists, with undefined and persistent brain symptoms.

Treatment by free incision.

Symptoms of abscess beneath bone.

When, however, evidence exists that the inflammation has spread from the bone to the parts beneath, as indicated by marked symptoms of feverishness, severe headache, and probably rigors; with sleeplessness,

delirium, convulsions, and paralysis, particularly when hemiplegic, other surgical treatment may be thought of; for if these symptoms are associated with such a history as has just been sketched, there is every probability that suppuration exists within the skull, and that surgical art may reach it. General treatment, moreover, in these cases is both unsatisfactory and unsuccessful; and, if the case be left alone, bad results always follow. Surgical interference, it is true, as a rule is not very satisfactory, though some striking examples of success exist. In the hands of Pott, trephining the skull for matter beneath the bone outside the dura mater yielded a good result in five out of eight cases. No modern surgeon, however, can show a like success; "indeed," says Mr. Hewett, "the successful issue of a case of trephining for matter between the bone and dura mater is, I believe, all but unknown to surgeons of our own time." Nevertheless, the operation is clearly justifiable under such severe circumstances as have been described; although I cannot help feeling that Mr. Hewett's opinion is true, and that surgeons are too readily disposed in these cases of local encephalitis to wait too long, to trust too far to nature's own processes, and by so doing, to allow the local suppurative action to spread inwards beyond the dura mater to the brain itself, when the prospect of a successful result are certainly poor. They wait for what are called well-marked brain symptoms—coma and hemiplegia—before they interfere; which well-marked symptoms too often mean fatal brain complications. Trephining the seat of injury, therefore, under such circumstances is clearly justifiable if not hopeful, and the operation should be performed as soon as it is manifest from the history of the case that the local action is spreading. When pus is found between the bone and the dura mater great hopes may be entertained of a successful issue, although when the same suppurative action has involved the cavity of the arachnoid and the brain, the prospect is not good.

Question of trephining.

Necessity of early interference.

Puncturing dura mater in suppuration.

Should no pus be found, however, between the bone and dura mater, is the surgeon justified in opening the membranes? Without doubt he ought under certain circumstances, when, by the symptoms, there is strong reason to believe that pus exists beneath the injured bone; when the dura mater on exposure *bulges* firmly into the opening in the bone which has been made with the trephine, and if it be *tense*, as well as absolutely *pulseless;* for cases of success after this operation have been recorded by Guthrie, Roux, and Dumville. The evidence required to sanction any incision into the brain in search of suppuration, as has been already stated, must, however, be very strong; nor have I ever seen an instance in which it was justifiable.

Symptoms justifying such a step.

Encephalitis as result of pyæmia.

Acute encephalitis, as a result of blood-poisoning, needs only to be mentioned. It is a hopeless condition from the first, and is always associated with the worst and most general form of pyæmia.

TREATMENT OF CONCUSSION AND COMPRESSION OF THE BRAIN, AND OF FRACTURES OF THE SKULL.

General remarks.

"A mere crack in one of the bones of the cranium, *abstractedly considered*, is not more likely to produce any serious complaints than a simple fissure in any other bone; and if symptoms of consequence do frequently attend the accident, they proceed either from the bone being beaten inwards, so as to press upon the brain, or from the mischief done to the parts within the skull by the same force that broke the

bone itself. The same violence which breaks the cranium may occasion a concussion of the brain, an extravasation of blood in or upon it, or subsequent inflammation of that organ and its usual consequences." (Sam. Cooper.)

The truth embodied in this extract renders it necessary to consider the treatment of head injuries as a whole; since it is impossible to say, in any case of severe injury to the skull, whether two or more of the conditions mentioned are not associated.

Treatment in early stage to be expectant.

When brain concussion has taken place, it may or may not be associated with fracture; and it may or may not be followed by symptoms of compression, either from extravasation of blood or secondary inflammation. When a fracture is known to exist either with or without depression of bone, the difficulty is not lessened; the brain symptoms may be simply those of a passing concussion, or they may be those of a much more serious injury, such as brain contusion, laceration, or blood extravasation. The severest complications are often ushered in by the mildest symptoms; and therefore the surgeon should always treat every case of injury of the cranium and its contents as serious, as also to be as guarded in his prognosis as he must be uncertain in his diagnosis. "We know not what injury may have been sustained or what symptoms may supervene; we therefore wait for the subsidence of the first impressions, or the development of fresh mischief, and shape our course accordingly." (Cock.)

Treatment of mild case of concussion.

In any case, therefore, of concussion, however slight, the patient ought to be kept quiet for a few days, observe moderation in diet, and particularly in the use of stimulants. If he moves about it is at a risk —a risk of secondary inflammation of the concussed or shaken brain, which may prove fatal.

Of severe concussion.

In severe concussion, that is, after an injury to the head which is followed by a more or less complete suspension of the functions of the brain, whether with or without a fracture, equal care is needful. Should the collapse indicative of the first stage be severe, it may be necessary to hasten reaction by means of warmth to the body generally, more particularly to the feet, and, by the application of some stimulant to the nostrils. It is seldom right to do more than this; because if reaction does not reappear naturally, or is not hastened by the means mentioned, it is tolerably certain that the brain mischief is of a severe if not fatal character. Under these circumstances, any more powerful means, such as the administration of alcoholic stimulants or powerful enemata, are likely to excite reaction to excess, and thus encourage secondary hæmorrhage or inflammation within the skull.

Collapse.

Caution in hastening reaction.

Avoid alcoholic stimulants.

Reaction and its treatment.

When *reaction* has set in after the collapse—the *second stage* of authors—every source of excitement, mental or physical, should be removed. The patient should be kept in bed with his head raised and shaved, and the bowels emptied with a mild saline purgative, or a mercurial purge. If the head be hot, the pulse rapid, and other symptoms of general febrility and brain excitement show themselves, cold lotions or an ice-bag may be applied, and particularly the latter. When the symptoms of excessive reaction are persistent, the commencement of traumatic encephalitis should be suspected; and under these circumstances active treatment is doubtless required, inasmuch as when acute symptoms of inflammation of the brain or its membranes appear, paralysis and a fatal coma are not far off.

Venesection. Venesection boldly performed at this stage of the disease, so as to affect the pulse, is a good remedy. It may even be repeated should the symptoms return and the pulse and temperature rise. In feeble patients, however, bleeding is inadmissible, and under all circumstances it ought only to be resorted to after careful consideration.

Cold to head. Ice to the head or a stream of cold water passed over it are means that ought never to be neglected. Powerful purgation, also, is valuable. The diet should be liquid and of a simple kind. Milk, when it can be taken, is the best, but when it cannot, weak beef tea or broth should be given, and then only in moderation.

Treatment of fracture and concussion. Concussion of the brain, complicated with either simple or compound undepressed fracture or fracture of the base, is to be treated upon like principles, with equal persistency and care, for simple fractures of the vault, compound fractures of the vault, and simple fractures of the base or of the vault and base combined, *unassociated with displacement*, require no special treatment beyond that indicated by the brain symptoms.

It should be here stated that the treatment of all these conditions is to be continued for at least a month or six weeks after the injury, because many are the cases on record in which secondary inflammatory symptoms appeared at least a month after the accident, or after the subsidence of the primary symptoms.

Treatment of compression. *Treatment of compression.*—When the brain symptoms following an injury to the head partake more of the nature of compression, that is, when they are persistent in their character, and, instead of going on towards recovery, or the restoration of the natural functions of the brain, tend rather towards their more complete abeyance; other questions of treatment come before the surgeon, and the most important has reference to the fact whether surgical art can do anything towards relieving the condition.

Surgical interference useless in general injuries of the cranium and its contents. The student who has carefully read the remarks that have already been made can now understand, when the injury to the brain or skull has been the result of some *general injury*, such as a fall upon the head from a height, or a blow from a heavy body, that the brain mischief which follows is certain to be of a general character, and when symptoms of local mischief complicate the case, little good is to be gained by treating these local symptoms when others of a more general or fatal character exist. In examples of brain or skull injury, therefore, as a result of diffused or general shaking of the head and its contents, local interference of any special character is generally useless.

Surgical interference justifiable in local injuries of the skull and its contents. Depressed fracture. In *local* injuries, however, the question may be seriously discussed. In cases of *depressed fracture*, ought the bone to be elevated? and should the fact of the fracture being compound influence the decision? I have no hesitation in answering both questions, and asserting that in neither instance ought surgical interference to be thought of unless the symptoms of compression are marked or persistent; for experience has taught us that depressed bone *per se* may exist to a great degree without giving rise to any serious brain complications, and that when even brain symptoms follow as an immediate result of the injury, they may all pass away.

Extravasation of blood between bone and dura mater. Should, however, the symptoms indicate the presence of effused blood beneath the fracture, sufficient to cause compression of the brain,

as shown by the lapse of an "interval of time" between the accident and the symptoms; and should local paralysis point out its seat; surgical interference is called for, and in both simple and compound fractures the trephine may be required in order to elevate the bone. The operation is necessary on account of the brain symptoms present in the case, and has no reference to the character of the local injury,—to the presence or absence of a scalp wound.

In *compound fracture* of the skull, however, associated with *depression and comminution* of the bone, both with or without brain symptoms, the surgeon ought to remove loose pieces of bone, and may elevate the depressed portions when this can be done with the elevator without difficulty, as splintered bone is always a dangerous body when in contact with the dura mater. In comminuted compound depressed fracture remove fragments and elevate.

When the brain is injured the same course should be followed, the greatest care being observed not to add to the irritation by any rough manipulation. Should difficulty be felt, however, in removing bone it had better be left *in situ* rather than by interference incur any extra risk of injuring the brain or its membranes.

Should there be, on the removal of bone, severe hæmorrhage from a meningeal artery, the piece should be left; and should this practice fail to arrest the bleeding, a small piece of sponge inserted beneath the bone may succeed, or the application of a pair of spring forceps may be called for. It is not often, however, that such a complication is met with.

In all cases of *punctured fracture* of the skull trephining should be resorted to.

It thus appears that in simple or compound *uncomminuted* depressed fracture from a local injury no operative interference is called for, unless associated with marked symptoms of compression of the brain, or extravasation of blood between the bone and the dura mater. In compound *comminuted* fracture, also in *punctured* fracture, with or without symptoms of brain compression, it is wise to elevate the bone and remove all fragments. In other cases, as in fracture of the base, no surgical interference can be justified. General summary to surgical interference.

Did space permit, many instances might be quoted to illustrate these points. Cases of fracture of the skull with depressed bone, in which recovery has taken place, are numerous; indeed, it is most remarkable how much depression of the bone may exist without giving rise to brain symptoms, and I am almost tempted to believe that depressed bone by itself never gives rise to marked symptoms of compression, and when these are present hæmorrhage exists with it.

Many cases might also be quoted illustrating the value of surgical interference in compound fractures with depression; I give the following: Compound fracture of skull with depression from local injury. A feeling of permanent weight on the head was the only symptom, which was at once relieved by removal of the bone, and recovery followed. Cases in elucidation.

Compound fracture of skull with depressed bone from local injury. Constant vomiting, and pain in the head which was relieved at once by removal of the bone; the patient recovering on the fourth day.

Compound fracture of skull with depressed bone from local injury. Persistence of symptoms of oppressed brain. Elevation of depressed bone; and rapid recovery.

THE OPERATION OF TREPHINING OR FOR THE ELEVATION OF DEPRESSED BONE.

Fig. 71A.



Elevator.

Fig. 71.



Showing the operation of Trephining.

A. Trepbine prepared for use, with centre pin down.
B. With centre pin withdrawn, the outer table having been divided.

Fig. 71B.



Hey's saw.

"Much has been written and said on the treatment of injuries to the head; and the result of modern experience and judgment has so far altered the practice of our predecessors, as to render us cautious of inflicting an additional injury on our patient for the sake of gratifying au impertinent and useless curiosity as to the exact nature and extent of the original lesion." Thus wrote my colleague, Mr. Cock, nearly thirty years ago, and what he then said is true now, although, perhaps, surgeons at the present day are less disposed to trephine in head injuries than they were even at that time.

Statistics.

At Guy's Hospital trephiniug and elevation of bone for head injuries have been performed in fifty-one cases during seven years, and of these only twelve recovered. At St. Bartholomew's Hospital it was recorded by Callender in 1867, that the operation had not been performed for six years. At University College, Erichsen gives six cases of recovery out of seventeen.

Circumstances under which trephining may be of use.

The operation is likely to be of use in two classes of cases:

First.—To relieve compression of the brain from depressed bone or from extravasation of blood.

Secondly.—To prevent, check, or relieve irritation of the brain or its membranes when caused by (1) depressed and comminuted bone, by (2) inflamed and swollen bone (whether the result of accident or disease), or by (3) an accumulation of pus between the bone aud dura mater compressing the brain; and, it may be stated, at once that the operation of trephining gains more support from the second than from the first group of cases.

Trephining for depressed bone or extravasation rarely wanted.

With respect to the first it will have been gathered from preceding chapters that depression of the bones of the skull is rarely sufficient of itself to give rise to persistent symptoms of compression; that

when it is, the injury has probably been of such a severe nature as to produce grave intracranial complications, from which any operation would be incapable of affording relief; and that hæmorrhage between the bone and the dura mater is rarely so uncomplicated with brain mischief as to render it probable that the operation of trephining will be successful.

When, however, it can be fairly determined that brain symptoms of a defined and aggravated character are the result of either of these two causes, separately or combined, the operation of trephining may be performed. In diffused injuries to the skull the probabilities are all against the operation; while in local injuries they are in its favour.

Only justifiable when the symptoms are very marked.

In both simple and compound fractures of the skull, with or without depression of bone, the symptoms of compression of the brain, as a primary result of the accident, must be very marked indeed to justify the operation of trephining; although in *compound fractures* it is expedient to elevate depressed bone, when any symptoms of brain irritation manifest themselves, such as local pain and weight, spasms or convulsions; and that under all circumstances it is best to remove fragments when the bone is comminuted. In a compound comminuted fracture of the skull the dura mater is probably exposed, and is likewise irritated by the broken bone. A careful elevation of the depressed portion of the bone and the removal of the comminuted fragments can in no way add to the mischief, but must tend towards its diminution.

Elevation of depressed bone in compound fractures.

Remove fragments of bone.

In *local injuries* whether simple or compound, when incipient symptoms of brain irritation or inflammation appear two or three days after the injury, the use of the trephine is indicated, inasmuch as there is a probability that the symptoms originate in the presence of a fragment of bone irritating the brain or its membranes, which if left must go on to set up encephalitis.

Trephine when incipient symptoms of encephalitis exist.

In all cases of *punctured fracture* the trephine should be employed.

In *diffused injuries* to the cranium and its contents trephining is useless.

When an abscess can be made out as existing between the bone and the dura mater after a head injury, the operation of trephining is demanded, though the diagnosis of such cases is difficult. The chief indications are found in the prolonged period which frequently elapses between the injury and the supervention of the symptoms, their gradual and, it may be said, irregular approach, the general and cerebral irritation that is present as a rule, the exacerbation of all these symptoms, and, above all, the constant headache.

Pus between dura mater and bone.

The direct symptoms of compression produced by the formation of pus are, moreover, in no ways so definite as those afforded by blood extravasation; they are of a less decided nature, and are never associated with the deep-toned stertor and rapid progress of the symptoms, "which, with overwhelming influence, quickly annihilate both motion and consciousness when blood has been poured out in any considerable quantity after injury to the cranium." (Cock.) They are, however, fairly marked by the clinical history of the case, and can be generally recognised.

The operation of trephining.

The instruments required for the operation are the *trephine*, or circular hand-saw, of which there are two sizes; a *small saw*, with a straight and circular edge, generally known as Hey's saw; a *sharp scalpel*, with a handle rounded at the end, to press back the periosteum and soft parts from the bone; a *flat probe*, thin enough to introduce

Instruments required.

into the groove made by the trephine, to guide the surgeon in his attempt to perforate the bone, and to prevent him going too far; a pair of *cutting forceps*, to remove sharp points and edges of bone; *an elevator*, to raise depressed bone; and dissecting, dressing, and torsion forceps. (*Vide* Figs. 71A and B.)

Position of patient.

The patient's head having been placed upon a pillow, *shaved* so far as requisite, and held firmly, the first thing the surgeon has to do is to expose the bone he wishes to perforate or elevate. This must be done freely, either by enlarging the wound that previously existed

Incision.

or by a crucial incision. The soft parts should be divided by one cut down to the bone, and these, including the periosteum, should be gently pressed back with the handle of the knife. Bleeding at this stage should be arrested by ligatures, torsion, or the application of a cold sponge and pressure.

Removal of fragments.

Supposing the case to be one of fracture with depression, and that fragments of bone exist, they should be removed, great care being taken in their removal not to twist the broken bone, and thus run the risk of tearing the dura mater; and when an opening is thus formed, the depressed bone may be raised by means of the elevator carefully introduced beneath its free border. To facilitate this proceeding, perhaps the removal of a piece of projecting bone by forceps or Hey's saw will be found beneficial, and if so the trephine is not required; for the surgeon's object, under these circumstances—to raise the depressed bone and remove the comminuted portions—may be completed without the trephine.

Application of trephine.

Should the bone be so depressed, however, as not to present an edge for the surgeon's forceps, as is seen in the "gutter" fracture illustrated in Fig. 63, the trephine must be employed. The instrument should be previously prepared, the central pin being made to project sufficiently far to perforate the external table, and so fixed as to allow the saw to bite the bone. (Fig. 71A.) In a depressed fracture this pin *should never be placed upon the fractured*, but upon the border of the sound bone. The instrument is then to be applied, and the external table cautiously divided with a few semi-rotatory movements of the surgeon's wrist. A groove having been made deep enough to allow the saw to work steadily, the instrument is to be removed and the central pin withdrawn and fixed (Fig. 71B), as it would be a fatal error to go on working with the pin projecting through the inner plate of bone into the dura mater. The surgeon ought now to proceed with the utmost caution; and feel his way every few turns with the flat probe, for as soon as he has divided or even reached the inner plate the elevator may be employed and the loose ring of bone removed. When the inner plate is fractured to a greater extent than the outer, it may not be necessary to divide it, the removal of the external table with the diploë being sufficient to allow of the introduction of the elevator, and the elevation

Care in perforating inner table.

of the depressed inner table or the removal of fragments. Should this, not be the case, however, the inner table must be perforated, for the whole thickness of the bone must be removed. The operator cannot be too careful at this stage of the operation; and should always proceed with the conviction that the bone is thinner at one spot than at another, and further, that "there is only the thinness of paper between eternity and his instrument." (Sir A. Cooper's MS. Lectures.) The depressed bone may then be raised by the elevator.

If the operation has been performed for extravasation of blood beneath the bone, and a clot be discovered, it should be removed; the utmost gentleness being used. Should pus exist, it will escape naturally.

Should troublesome hæmorrhage from a meningeal artery ensue it may be arrested by tucking a small portion of sponge or a small piece of wool beneath the vessel and compressing it against the bone, or it may be held by a short pair of spring forceps against the bone. Free bleeding of this kind, however, is not frequent. After-hæmorrhage.

If, however, no blood or pus be found external to the dura mater, and strong evidence exist that it is placed beneath this membrane, the dura mater may be punctured. This step, however, is not to be undertaken without grave consideration. Yet, it may be asked, if the operation fail in its object, is the operator ever justified in making a second opening into the skull, in search of blood or of pus? Certainly it must be answered not at a hazard, although when there is evidence to point to a second position in which it is reasonably probable that the offending fluid may be found, a second perforation may be performed; cases are on record in which three or more pieces have been removed with a good result. On puncturing the dura mater. On making a second opening in the skull.

The wound, after the operation, must be treated on general principles; the edges of the soft parts being gently brought together, but not stitched; water dressing is the best application, and the head should be kept cool by the ice-bag. If the parts heal, and the case does well, a metallic shield will probably be required as a protection, although it is interesting to see how firm the membrane that fills in the cavity becomes after a time. After-treatment.

Should a hernia of the brain follow at a later stage, the same local treatment should be employed. Excision of the projecting fungous mass is a practice that is not advisable. The whole will probably wither by natural processes if a cure takes place, and the less the surgeon interferes the better. Hernia cerebri.

General Conclusions on Injuries of the Head and their Treatment.

1. Injuries of the head are of importance only as far as they involve the cranial contents, a case of simple uncomplicated fracture of the skull being of less danger than one of general concussion of the brain.

2. A slight concussion of the brain, which manifests itself by a slight or passing suspension of the cerebral functions, associated or not with a fracture of the vault or of the base of the skull, generally does well.

3. A severe concussion or shaking of the brain associated or not with a fracture of the vault or of the base of the skull, is liable to be associated with contusion or laceration of the brain substance, either upon its surface or within its ventricles, and with more or less extravasation of blood; when the vessels are diseased, a copious hæmorrhage often follows a slight injury.

4. In cases of severe concussion, the brain is at least as much injured by *contre-coup* as it is at the seat of injury, its base suffering the most. Fracture by *contre-coup* does not take place.

5. A fall upon the vertex from a height, or a blow upon the head from a blunt instrument, may or may not be followed by fracture of the skull, such an accident producing, as a rule, a general concussion of

the brain, with such complications as contusion or laceration of the brain and effusion of blood either upon its surface or within the ventricles.

6. Falls upon a pointed object, or blows with a sharp instrument, are, as a rule, followed by local fracture; and if the brain be injured, it is at the seat of injury. As a consequence, the symptoms may be accounted for by local causes only, and the surgical treatment should be directed by local considerations.

7. When symptoms of compression of the brain immediately follow an injury to the skull which has been produced by a fall from a height, or by a blow from a heavy and blunt instrument, the cerebral injury will be general, the brain will be contused and lacerated, particularly at the base, by *contre-coup*, and if extravasated blood be found external to the dura mater, blood will also be found upon the surface of the brain, or within its membranes. The operation of trephining under these circumstances can be of no avail.

8. If symptoms of compression of the brain follow a local injury produced by a fall upon a sharp object, or a quick blow from a pointed one, such symptoms, as a rule, are produced by local causes, such as depressed bone, or extravasation of blood from a ruptured vessel, and such local injuries should be treated by the elevation of the depressed bone or by trephining.

9. When compression of the brain follows a local injury over the course of the meningeal artery, and the symptoms come on after reaction has been established, and the lapse of an interval of time from the receipt of the injury, although no depressed bone be present, the operation of trephining may be performed.

10. Encephalic inflammation may follow any concussion or injury to the brain, however slight, whether complicated or not with fracture; the danger of such a result being in proportion to the encephalic injury. In cases of contusion or laceration of the brain with extravasation of blood, it is almost sure to occur, and, as a rule, will cause a fatal termination. This inflammation may appear within a few hours of the accident, or it may be postponed for a few days; it may be very rapid in its course, or very insidious in its nature. If the brain alone be affected, either a diffused or local abscess may result; while if the membranes are involved, effusions, convulsions, general or partial paralysis, coma, and death, will rapidly take place.

11. Fractures of the base of the skull may take place alone, and be marked by only special symptoms. They may be associated with, and are generally found in, all cases of severe fracture of the vault, when produced by a heavy fall or blow, the fissures radiating downwards in a direction parallel to the forces employed.

12. Fractures of the base may be complicated with encephalic injuries similar to those which complicate fractures of the vault, consequently they may be manifested by general as well as special symptoms; and in severe cases the former completely mask the latter.

13. All injuries to the head should be treated with extreme care and always regarded as serious. Rest in the horizontal posture, freedom from excitement, bland, nutritious, unstimulating food, being essentials under all circumstances; the great principles of practice consisting in warding off excess of reaction and inflammation of the cranial contents.

DISEASES OF THE SCALP AND CRANIUM.

Besides the blood tumours of the scalp to which attention has been already directed, the head is very frequently the seat of the common skin or *sebaceous tumour* which is called a "wen," these morbid growths indeed, are more frequently found on the head than on any other part of the body. They are more common also in women than in men, seventy out of one hundred and seven consecutive cases of sebaceous cysts which I have analysed having occurred in women and eighty-four on the head. In many instances these wens are doubtless due to an obstruction of the duct of a sebaceous follicle, as the orifice of the duct is often visible, and through it the contents of the cyst can be squeezed; while in others no such obstruction can be made out, it being probable that some of these tumours are new formations—true adenoid tumours of the skin, when the tumour lies beneath the skin, but has no connection with it. In *congenital* sebaceous tumours, this position is very common, although perhaps the cyst is more frequently situated beneath the fascia, or even beneath the muscles, of the part. When about the orbit—their most common seat—these cysts are always deeply placed, and often have close connection with the periosteum. They, moreover, almost always contain hair. By their pressure upon the bone they at times cause its absorption and perforation. The contents of these cysts vary; in some the secretion is milky, in others more solid and cheesy; and in a third the contents are cretaceous. When degenerating, they may be filled with a blood-stained blackish fluid, and at times are most offensive, having a peculiar sour smell.

Wens or sebaceous tumours of the scalp.

In neglected examples of this disease the contents of the tumour may soften down, and, causing suppuration, escape externally by ulceration. From the inner surface of these evacuated cysts a new growth may spring up of a peculiar nature; and this, forming an irregular, fungating, bleeding surface, at times puts on an appearance which has been mistaken for cancer. On examining the edges of the wound, however, such a mistake can hardly be persisted in, for it will be at once observed that the edges of the wound are healthy and not infiltrated with new matter, as would be the case in cancer—this irregular fungating growth consisting of exuberant granulations from the cyst itself. Abernethy described these growths years ago, but in more modern times the best account is given by Mr. Cock, in 'Guy's Hosp. Reports,' 1852.

Ulcerating follicular tumours.

Simulates cancer.

In other cases, again, a horny growth springs up from the interior of the cyst. I have removed one of twenty-one years' growth (Fig. 17, p. 106) from the head of a man æt. 70, upon which were wens of different sizes.

Treatment.—The only correct treatment of these cysts, whether whole or broken, is their removal by excision; and in doing this it is needless to be too careful to dissect the cyst out entire; the most expeditious method is to slit open the tumour with a bistoury, and turn it out with the forceps or handle of a knife. This plan is rapid and effective, and far superior to the older and unnecessary one of a steady dissection. In some cases of long standing, however, dissection is required. In children, the cysts may frequently be squeezed out of their bed by the thumb and finger.

Treatment.

It is common to hear of the danger of erysipelas after these excisions, but such a fear is groundless. The excision of the congenital tumour

Erysipelas.

is sometimes difficult on account of its close attachments, and unless all the cyst is removed a return of the growth may be looked for. Some surgeons consequently advise the careful dissection of the cyst; I have generally found, however, a free incision into it, and the removal of its walls by the scalpel or scissors to be sufficient.

Other tumours.

The scalp may likewise be the seat of other tumours, *simple* or *malignant*, of *epithelial* cancer of the skin, or of any other affection of the integument. These require no special attention here.

Nævi.

Nævi are very common in all their forms—cutaneous, subcutaneous, or mixed; but this subject will be considered in another chapter. Let me caution the student, however, not to adopt hastily any surgical proceedings with a nævus situated over a fontanelle, for although such may be dealt with with impunity I have known a fatal inflammation attack the membranes of the brain after the application of a ligature to an undoubtedly cutaneous nævus placed over this region. If possible he should wait till the bones have closed before he interferes.

Perforating tumours of the skull.

Perforating tumours of the skull occasionally come under the surgeon's notice, and demand attention. The majority of them have their origin from the membranes covering the brain, and mainly from the dura mater. They are generally *cancerous*, and are often secondary deposits; though occasionally they seem to be of the "*fibroplastic*" nature. They were first described by Louis in 1744, under the term "fungus of the dura mater" ('Mém. de l'Acad. Roy. de Chir.,' tome v). Since his day all perforating tumours of the skull have been included under this heading. It must be remembered also that a tumour growing within the skull, and pressing outwards, will cause absorption of the cranial bones, and this fact is rendered familiar to pathologists by the enlargement of the Pacchionian bodies.

Symptoms.

The symptoms indicating the presence of this affection are very uncertain, although headache, more or less constant and severe, may exist with epileptiform convulsions and other brain symptoms; yet, as often as not, the first marked condition to which the patient's attention is directed is a swelling in one of the bones, the disease having progressed thus far without having given rise to any symptoms whatever. When the diseased mass has perforated the bone the swelling receiving its impulse from the brain, will be pulsatile, and this symptom is of importance, as a distinctive one between tumours of the bone itself and the perforating tumours of the membranes. In cancerous disease the bone itself will be infiltrated with cancerous elements and destroyed, while in benign tumours the bone will be absorbed simply by pressure, as is seen in aneurism. In the former case the opening in the bone will be ill defined and irregular, and in the latter it will be smooth as well as regular.

Distinction between cranial and intracranial tumours.

Treatment.

With respect to treatment, it is almost needless to say that nothing can be done by way of removal of the growth. The symptoms to which it gives rise can only be relieved by sedatives, and life prolonged by general treatment.

The bones of the skull are liable to tumours, cancerous or benign, to exostoses, particularly of the ivory kind, and to myeloid growths; though in this place it is only necessary to mention the fact.

Meningocele and Encephalocele.

Meningocele and Encephalocele.

These terms are applied to conditions of the head found in children at

the time of birth, and infants thus affected are generally hydrocephalic. The words indicate a protrusion through the skull either of the membranes of the brain or of the brain itself; the protrusion appearing as an elastic tumour in the line of one of the sutures. Such cases are always associated with some deficiency of the bones of the skull, it may be of some portion of the frontal bone, near the root of the nose (Fig. 72) or near its external angular process, and by far the most frequently of the occipital bone. In rare examples the deficiency may be at the base of the skull. Dr. Lichtenberg has recorded a case in the 'Transactions of the Pathological Society,' vol. xviii, in which the tumour was hanging out of the child's mouth, and communicating with the skull through an opening in front of the sella turcica.

Varieties.

In a *meningocele* the membranes, may protrude as a whole; but sometimes the dura mater alone projects (*vide* Prep. 1563[60], Guy's Museum). In the true *encephalocele*, the brain itself is pressed out of the skull into the external tumour. This was well seen in a patient of Dr. Lever's, from whom the accompanying drawing (Fig. 73) was taken; the skull contained the anterior and part of the middle lobes of the brain and the sac the remaining portions. The ventricles were likewise divided between the two. The posterior lobes were adherent to the membranes that formed the sac. In a *hydrencephalocele*, in addition to the brain substance, there will be a portion of one or both of the ventricles filled with fluid.

Fig. 72.



Meningocele at root of nose. (Mr. Poland's case.)

Fig. 73.



Encephalocele.
(Drawing 501[30], Guy's Hosp. Mus.)

"An *encephalocele*," writes Mr. P. Hewett ('St. George's Hosp. Rep.,' vol. vi), "is of a round or oval shape; in size it seldom exceeds that of a small orange; its attachment is broad; the integuments covering it present little or no alteration. In the earlier periods it has the characteristics of a watery bag; but later on, as the fluid gradually

disappears, the brain matter fills the sac, and then the tumour becomes soft and doughy."

A *hydrencephalocele* "in shape is more or less pyriform, with a marked contraction at its attachment, and sometimes a long and narrow stem; in size it is apt to become much larger than an encephalocele. The integuments over it are thinner, fluctuation exists about the hernia, and large veins may be traced under the skin."

May simulate a cystic tumour.

When these tumours are small and have a very minute communication with the cranial contents, they have been and may be again mistaken for some simple cyst or tumour. The surgeon should therefore always suspect that a cystic tumour, situated in the median line, over a fontanelle or suture and particularly when over the nose, may have some communication with the membranes, and he should consequently

Natural cure.

postpone all operative interference till the diagnosis is clear. As the bones ossify, the opening between the tumour and the cranial contents

Treatment.

may close. The cyst, if small, may then be excised; if large it may be injected with iodine or Morton's iodo-glycerine solution. The utmost caution, however, must be employed in the treatment of these cases, and where uncertainty exists as to their true nature or attachments, the prudent surgeon had better leave the case to nature than risk life by any hazardous enterprise.

Ostitis and periostitis.

Ostitis and periostitis of the bones of the cranium are common affections and may occur either as a consequence of a local injury, of syphilis, or of other causes. They are also often associated with brain complications. Under the heading of traumatic encephalitis this subject was discussed, together with its treatment, and ostitis coming on from any cause other than injury presents very similar symptoms. I have seen in an infant periostitis the result of hereditary syphilis, and ostitis ending in necrosis. I have seen also half the frontal bone of a babe exfoliate after a punctured wound from a nail, without any brain symptoms. In the adult the complications attending inflammation of the bones, syphilitic or otherwise, are very variable.

Symptoms.

The symptoms are generally local so long as the inflammation is confined to the periosteum covering in the bone, the chief being pain and tenderness, with local swelling; though when the inflammation has spread to the inner periosteum or dura mater, other symptoms appear; such as constant headache, and great irritability of brain; any worry or work increases pain, causes fever, restlessness, and want of sleep. As the disease progresses delirium, convulsions, paralysis, coma, and death, may be the result.

May terminate in suppuration and necrosis.

The inflammation in the bone may go on to suppuration, or necrosis; the dead bone may exfoliate in masses (Fig. 74) or in small portions. Should no external outlet for the pus exist, it will press inwards and aggravate the brain symptoms; and, if no external vent to the suppuration be made, either by natural processes or by the surgeon,

Confined pus may cause compression.

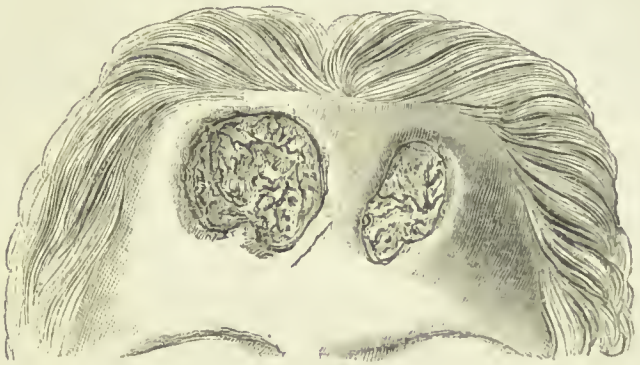
the retained pus within the skull may give rise to symptoms of compression of the brain, when it is probable that the brain itself and its serous membrane are also involved, and the case becomes a most serious one. It is, consequently, a point of great importance for the surgeon to anticipate such a complication, and, if possible, to prevent it, and this leads me to speak of the treatment of the affection.

Treatment of early symptoms.

When a patient has had a blow upon the head, or been the subject of syphilis, and as an after symptom a local swelling appears, or pain of a

constant and wearying character, the suspicion should be excited of these symptoms being due to a local ostitis. When the swelling is tender to the touch and pain is aggravated by local pressure, this suspicion should be strengthened; and when these conditions are attended by

Fig. 74.



Necrosis of frontal bone (from Emily S—, æt. 19). June, 1870.

pyrexia more or less severe, sleeplessness, a quick irritable pulse, and a contracted pupil, a local inflammation of the bone may safely be diagnosed, the inflammation probably involving the dura mater within and the periosteum without. Under these circumstances a free incision down to the bone should be made, since experience has proved that by the adoption of this practice, pain and other symptoms are, as a rule, relieved, and serious brain complications are often prevented. When external suppuration with the exposure of dead or dying bone is present, it is less common to meet with cerebral symptoms, since the pus finds its way externally through the wound, and there is consequently less irritation and pressure on the dura mater, as well as less brain irritation. Should, however, brain complications appear, it is important for the surgeon to interfere, to prevent their spreading, as when confirmed brain symptoms have manifested themselves, the case is almost hopeless. The surgeon, under these circumstances, should attempt to remove the necrosed bone, or perforate it by the trephine —both these operations having one common object, viz. to give free vent to the pus beneath the bone.

Free incision.

When external suppuration exists.

Removal of dead bone.

Trephining, under such circumstances, is not only a justifiable, but, probably, a valuable operation, and if performed with care, can do little harm. When operation is postponed till confirmed brain symptoms have appeared there is too much reason to believe that irremediable changes have taken place, such as suppuration within the hemisphere or arachnitis, which no operation is likely to relieve. Trephining has, however, been of use even in such cases when complicated with epileptiform convulsions; but the surgeon should anticipate this stage of the disease when he can, and interfere before such symptoms appear; headache of a local and persistent character, associated with evident signs of local ostitis or necrosis, is always an indication of the propriety of trephining.

Trephining.

I need hardly add that constitutional treatment such as has been mentioned under the heading of encephalitis and will be alluded to

when the subject of syphilis is considered, ought to be carefully followed out.

M. Aran, 'Archives Générales de Médecine,' 1844.—*Cock*, 'Guy's Hosp. Reports,' 1842.—*Hewett*, 'System of Surgery,' by Holmes, Sec. Ed., 1870.—*Le Gros Clark*, 'Lectures at Royal College of Surgeons,' 1869.—*Pott*, 'Injuries of the Head,' 1768.—*Guthrie*, 'Commentaries in Surgery,' 1853.—'Erichsen's Surgery,' 5th Ed., 1869.—Hutchinson's Prize Essay (Astley Cooper), 1865.—*Brodie*, 'Med.-Chir. Trans.,' vol. xiv.—*Wilks and Moxon's* 'Lectures on Pathology.'—*Callender*, 'St. Bartholomew's Hosp. Reports,' vols. i and iii.—*Hilton*, "Clinical Lectures," 'Lancet,' 1853.—*Nélaton*, Attlee's edition, 1855.—*Gama*, 'Traités des Plaies de Tête,' 1835.—*Adams*, 'Cooper's Surg. Dictionary,' 1861.—*J. Neudörfer*, M.D., Prague, 'Handbuch der Kriegschirurgie,' 1867.—*Pirogoff*, N. Leipzig, 1864.—Stromeyer's edition of *W. Mac Cormac's* 'Notes of an Ambulance Surgeon,' 1871.

ON TRISMUS AND TETANUS.

Definition.

When a patient is the subject of an uncontrollable spasmodic contraction of the muscles of the lower jaw, he is said to have "*trismus*" or lockjaw; and when the same condition attacks other or all the voluntary muscles of the body, he is said to have "*tetanus*." Tetanus includes trismus, and generally begins with it; though trismus may be a local affection. It is found in children as a result of dentition, and in adults, as a consequence of diseases involving the teeth, gums, or jaws. It is a spasmodic affection, produced by reflected irritation set up by a local disease, is rarely associated with any constitutional disturbance, and is, for the most part, cured on the removal of its cause.

Varieties.

Tetanus is likewise generally associated with some local source of irritation, some wound or injury; and is then called "*traumatic*." When no external or visible cause can be made out, it is denominated "*idiopathic*." When rapid in its course, it is called "*acute;*" when slow, "*chronic*." The acute form is usually the result of an accident, and generally fatal. The chronic is for the most part idiopathic, and more curable.

Infantile tetanus.

Tetanus nascentium.—Tetanus is met with in new-born infants, and is then known as *trismus nascentium*, or *tetanus infantum*. It usually comes on the second week after birth, and may be so acute in its course as to destroy life in from ten to thirty hours; or life may be prolonged to eight or nine days. It is a common affection in the West Indies, and has been known to occur frequently in ill-ventilated lying-in hospitals. Bad ventilation consequently has been put down as one of its causes, the others being cold, exposure, interual irritation, and the division of the umbilical cord.

Predisposing causes.

Predisposing causes of tetanus.—Dismissing the last form of the disease from our consideration, it seems that tetanus may be found at any period of life, though more than half of the cases occur between ten and thirty years of age. The youngest case on record was in a child of twenty-two months, and the oldest in an adult of seventy-five years.

It is more common in males than in females, and the proportion is as seven to one. It is found in the healthy as frequently as in the cachectic, nor do the intemperate seem more prone to its attack than the temperate. It is, too, as frequent in the winter as in the summer months; though in warm climates the natives are more susceptible to its attacks than Europeans. Exposure to damp, cold, or sudden changes of temperature, have doubtless a powerful influence in exciting this disease, both in the idiopathic and trau-

matic forms. Larrey stated that after a great battle, a hundred soldiers were found affected by it in one morning.

Exciting causes.—Tetanus is rare in the course of ordinary surgical disease, although it may follow any form of injury from the slightest contusion to the severest compound fracture. It may occur after the extraction of a tooth, or the gravest operation in surgery, and it is known in obstetric practice as *puerperal* tetanus. It is most common after the more severe varieties of accidents, such as burns, compound fractures, and injuries to the fingers and toes, though there is no evidence to prove that it is more frequent after slight injuries to the fingers and toes than to other parts. Lacerated seem to be more frequently followed by tetanus than incised wounds, particularly in children. The state of the wound appear to have any influence on the disease. Seven years' experience at Guy's Hospital gives the following facts (Poland). Exciting causes.

Tetanus occurred in	1	case out of	1394	cases of major and minor operations.	
,,	,,	9 cases	,,	594	,, of wounds of all varieties.
,,	,,	1 case	,,	856	,, of injuries and contusions.
,,	,,	3 cases	,,	456	,, of burns and scalds.
,,	,,	9 ,,	,,	398	,, of compound fractures.
		23		3698	,, or 1 in every 160 cases.

There is no definite period at which tetanic symptoms are prone to appear. When they set in soon after the injury, they are for the most part acute and very fatal; after the lapse of three weeks, the chances of their appearance are very small. Acute cases, however, occasionally occur during the second week; upon this point Poland gives us the following facts: Date of appearance.

Of 277 cases, 130 began before the 10th day, and of these 101 died.
,, ,, 126 ,, between the 10th and 22nd day, and of these 65 died.
,, ,, 21 ,, after the 22nd day, and of these 8 died.

In tetanus following exposure to cold the symptoms generally appear rapidly after the exciting cause, and with the same exciting cause, similar results occur in the traumatic form.

Symptoms.—There are no general or local premonitory symptoms by which the onset of this affection can be recognised, and the earliest indications of its approach are generally a difficulty in opening the mouth, with stiffness in the muscles of the lower jaw; yet these symptoms may be so slight as to pass unheeded, or be misinterpreted. When, however, some rigidity of the muscles of the neck, throat, or abdomen can be made out, and the first indications of the "tetanic grin," or *risus sardonicus*, recognised—this symptom being caused by the drawing down of the corners of the mouth, by the muscles of the face—the diagnosis becomes certain. Difficulty in swallowing will then soon appear (any attempt to drink fluids exciting spasm of the muscles of deglutition and often of respiration), with pain, due to spasm of the diaphragm, shooting through the body from the scrobiculus cordis. Symptoms.

Spinal muscles, terms used.

As the disease progresses the muscular system of the body generally will be more or less affected, and, in different cases, different groups of muscles will be involved. Those of the back are the most frequently attacked, and their contraction may be so powerful as to cause an arching backwards of the frame, producing what is known as *opisthotonos*. In rare cases, the body is bent laterally or forwards, the terms *pleurosthotonos* and *emprosthotonos* being respectively applied to such conditions.

Respiratory muscles.

The muscles of respiration are, as a rule, affected early in acute cases, and the chief danger to life consists in the severity of the spasms which attack them. When severe, the first spasm may be fatal, and may occur at an early or at a remote period of the affection. In a case under my care, of severe traumatic tetanus, all the symptoms were disappearing, and recovery was confidently expected; when, on the tenth day of the disease, the first spasm of the laryngeal muscles took place, which destroyed life.

When the jaw is unlocked by a spasm of the depressor muscles, the tongue is sometimes suddenly shot out from between the teeth, and often wounded.

Progress of disease.

As the disease advances the jaws become completely fixed, and deglutition is then impossible. The spasms of the muscles of the frame become more intense and frequent, and the powers of the patient rapidly decline. The pulse, which was rapid, becomes more feeble, while the expression of the countenance betokens agony of the body and despair of the mind. The slightest manipulation or movement of the patient sets up a fresh spasm, and any emotion may do the same. The skin becomes bathed with a cold sweat, and, if death is not caused by suffocation, exhaustion soon puts an end to suffering.

Absence of fever.

There is rarely any fever during the whole course of the disease, the bowels are always costive, the stools offensive, and the urine, as a rule, natural.

Intellect perfect.

The intellectual faculties of the patient almost always remain unimpaired throughout, while the senses are morbidly acute. Anything like delirium is rarely seen.

Should the case tend towards recovery, the spasms will become milder in character, and recur at longer intervals till they disappear. *It should be remembered, however, that, as long as the slightest evidence of disease exists, a sudden spasm of the glottis may at any time destroy life.*

Diagnosis.

Diagnosis.—This should not be a difficult task, and in every instance of lock-jaw, the possibility of its being the commencement of tetanus ought to be entertained. Local irritations, however, such as have been previously alluded to, only produce a locking of the jaw more or less complete, and are never accompanied by uncontrollable spasm, as is the case in tetanus.

From strychnine poisoning.

To diagnose between tetanus and poisoning by strychnine may be difficult, the symptoms of both being very similar, yet in tetanus the symptoms are progressive, while in poisoning they appear suddenly in all their severity. In tetanus, muscular rigidity is always present, and aggravated at intervals; in poisoning there are complete intervals of relaxation of muscle. In tetanus, too, there is constant rigidity of the muscles of the jaw; in poisoning, the jaw is

never locked except during the spasm. These points of difference are sufficient to assist the surgeon in the investigation of a doubtful case.

Again, hydrophobia and tetanus have been mistaken the one for the other, but any one who has seen the former disease could hardly fall into such an error. The peculiar restlessness of mind and body, the complete intervals of rest and absence of spasm, the peculiar aversion that is shown to fluid, accompanied by thirst, all symptoms characteristic of hydrophobia, are enough to distinguish between the two. Nevertheless, it should be remembered that Dr. J. W. Ogle, late of St. George's, has recorded a case of tetanus and hydrophobia combined. ('Brit. and For. Med. Rev.,' 1868.) From hydrophobia.

Prognosis.—In acute traumatic cases there are small hopes of recovery while in chronic the chances are greater. The longer the patient lives the better seem the prospects of a good result; and, if ten days pass after the first appearance of the symptoms, and the disease is on the decline, the prognosis is favorable. Prognosis.

Taking all cases together, Poland gives one recovery to seven and a half deaths. More than half die within five days. The most rapid death has been in from four to five hours; and the longest duration of life on record in a fatal case, is thirty-nine days.

How death is caused.—There can be little doubt that acute tetanus commonly destroys life by apnœa; spasm of the muscles of respiration and more particularly those of the larynx being the immediate cause. Poland tells us that this was the case in thirty-two out of forty-six cases at Guy's Hospital in which the mode of death was noticed. Mode of death.

In chronic tetanus, death is commonly caused by exhaustion. These facts have an important bearing on the treatment of the disease.

Pathology.—The late Mr. Wilkinson King, of Guy's, is stated by Poland to have been in the habit of remarking at the post-mortem table, whenever there was an examination of a case of death from tetanus, "Gentlemen, we will now proceed to give you a demonstration of a case of healthy anatomy, for there will be no visible morbid appearances otherwise than congestion of the organs in various degrees, owing to accidental circumstances." And at the present day these remarks hold good. It is true that Rokitansky, Demme, Lockhart Clarke, and Dickinson, have given us some descriptions of structural changes in the spinal cord which they have observed; and their observations moreover seem to coincide. These changes consist of disintegration and softening of a portion of the grey substance of the cord, which appears in certain parts to be almost diffluent. The semi-fluid substance thus formed, however, "is at first more or less granular, holding in suspension the fragments and particles of the disintegrated tissue, but in many places it is perfectly pellucid" (L. Clarke). Yet it is to be remembered that Billroth and other pathologists have failed to find these changes in the instances which they have examined, and it cannot therefore be accepted as certain, that these pathological conditions are constant in tetanus. There can be little doubt, however, that the nerves of the injured part are at times found inflamed and irritated, and from this fact, the theory has been advanced, that through the injured nerves of the part the spinal centres become involved, and manifest these states of excitement through the motor nerves by producing muscular spasm; the disease being one essentially of the excito-motory system. Pathology. Nerves of injured part inflamed.

Clarke believes "that the spasms of tetanus depend on the conjoined operation of two separate causes. First, that they depend on an abnormally excitable state of the grey nerve tissue of the cord induced by the hyperæmic and morbid state of its blood-vessels, with the exudations and disintegrations resulting therefrom. Secondly, that the spasms depend on the persistent irritation of the peripheral nerves, by which the exalted excitability of the cord is aroused."

Treatment. TREATMENT.—Every imaginable form of treatment has been employed in this disease with success, to be discarded in its turn for something new. No settled form of practice can consequently be laid down. Still, much can be done in guiding the patient through this disease; in keeping him alive; and in warding off death.

To keep the patient alive the most careful attention to feeding is required; milk and concentrated liquid animal food being the best
Diet. diet. If these can be taken in sufficient quantities, no other mode of administration is required; but if not, they must be given as enemata
Stimulants. every four or six hours as the case demands. Stimulants must be used cautiously, though when the powers are failing they may be freely given.

Quinine. Upon this principle of practice, quinine has been strongly recommended; it may be given in full doses to an adult, such as five grains every three or four hours, and then increased; or in one large dose such as twenty grains, to be followed by the smaller one.

Calabar bean. Among specific remedies that have been greatly vaunted, the Calabar bean stands foremost, and may be given in full doses, such as half a grain of the extract every two or three hours. Camphor also recommends itself to our notice in doses of from five to ten grains. The woorara poison has failed in its purpose. The bromide of ammonium or potassium has, however, been administered with advantage.

It was hoped that a valuable drug for this disease had been found in chloroform, but experience has not justified the expectation. The hydrate of chloral has now taken its place and been of some service. Demme
Curara. has advocated with much success the use of the Curara, eight cases out of twenty-two having recovered under such treatment. In India the Indian hemp has been highly recommended. Nicotine and tobacco have also been successful. Aconite is another drug that offers some advantages, while opium has an unquestionable influence in allaying pain
Ice-bags to spine. and mitigating the severity of the spasm. Ice also, applied in bags along the spine, has apparently been of great value in the hands of American surgeons. The administration of remedies by subcutaneous injection, in these cases, promises to be a valuable adjunct to practice enabling us rapidly to introduce into the system drugs that act antagonistically to tetanic spasm.

The patient should always be kept quiet, warm, and free from draught. He should, moreover, be so watched that in his spasms no injury can be sustained; attention should be paid to his bladder and bowels, for catheterism is sometimes called for; and purgatives or enemata to clear out the intestines are beneficial, although violent purgation cannot be advised.

Question of amputation. With respect to *local treatment* much may sometimes be done. In severe local injury when the nerves of the part are probably involved, amputation ought certainly to be performed; for a sufficient number

of cases have been recorded in which success has followed the practice. In 1845 Mr. Key amputated a leg on account of tetanus, which had appeared six days after an unreduced dislocation of the astragalus; the symptoms disappeared at once after the operation. On dissecting the foot the posterior tibial nerve was found to have been put violently on the stretch by the projecting astragalus. Case.

In some cases, soothing applications, such as opium, may be applied to the wound, and in all, perfect cleanliness should be enforced.

One other means of cure remains to be noticed, which has reference to the mode of death in this disease. It has been shown that in the larger proportion of cases—in all the acute—death is caused by suffocation from spasm of the laryngeal muscles. It is also fairly recognised that this disease runs its course, and that the most our science can accomplish is to maintain life and ward off death. To this end the operation of tracheotomy seems to be of value, for with a tube in the trachea, death by laryngeal spasm cannot take place, and a better prospect of recovery is consequently given. Tracheotomy.

I have employed this practice in one acute case, in which the Calabar bean was likewise given, and the patient sank from exhaustion, free from spasm; and there seems good reason to believe, that if I had performed the operation in the case I recorded in the early part of this chapter, life would have been saved. This matter, however, requires grave consideration, and the practice is not to be rashly followed.

Morgan, 'On Tetanus,' 1838.—*Curling*, 'On Tetanus.'—*Poland*, 'Guy's Hospital Reports,' 1857.—*Dr. Ogle*, 'Brit. and For. Med. Review,' 1868.—*Dr. Dickson*, 'Med.-Chir. Trans.,' vol. vii.—*Dr. L. Clarke*, Ibid., vol. xlviii.—*Dr. Dickinson*, Ibid., vol. li.—*Demme*, 'Schmidt's Jahrb.,' vol. 112.—*Thamhayn, O.*, Ibid.—'Year-Book,' Sydenham Society,' 1862-64, &c.—"Puerperal Tetanus," 'Dublin Quart. Journ.,' 1865; 'Med. Times and Gaz.,' 1865.—*Billroth*, 'Pathol. Chirurg.,' 1868.

DELIRIUM TREMENS.

It often falls to the surgeon to treat cases of pure delirium tremens uncomplicated with any surgical malady, and it is well, therefore, to refer to this subject by itself. There are other cases, perhaps, more aptly described by the term "*traumatic delirium*," in which the nervous symptoms are developed as a consequence of an injury received. Traumatic delirium. In both classes the symptoms are essentially the same, and the treatment required is similar, still it is right to bear in mind the difference in causation, as in the one we have to deal with a nervous disease in an intemperate person, and in the other, with the same symptoms as an incident in a surgical case. In simple delirium tremens, to use the familiar term, we have to deal with the case of a person who has indulged for an uncertain time in injurious doses of alcoholic liquors. It may be that a young man, after a prolonged debauch, has an attack of the "horrors," but the symptoms more frequently occur in those who have for a long period accustomed themselves to the excessive use of beer or spirits, even without amounting to drunkenness, and who at length are subjected to some shock or depressing influence. Inasmuch as the habits which have been mentioned as superinducing this disease are opposed to the simplest laws of health, it follows that they cannot be indulged in with impunity for long, and, consequently, we find the subjects of it, as a rule, of feeble powers of resistance, and often with diseased viscera. Such

persons are bad subjects for any ailment, and it often happens, that when a person of this sort breaks his leg or meets with some injury requiring surgical treatment, he becomes the subject of delirium tremens. Other causes are occasionally at work, such as starvation, mental anxiety, and the over-use of tobacco or opium.

Premonitory symptoms.

The disease is at times ushered in by certain premonitory symptoms, as patients who have once been the subject of an attack are sometimes conscious of the approach of another. A brewer who had been treated for this affection at Guy's some years ago, when he felt warnings of its advance, on several occasions subsequently applied for admission, and, as a result, the attack was warded off.

Depression of mind and body are the chief premonitory symptoms, with restlessness and agitation, gloom and foreboding of evil. Some slight febrile disturbance may also exist, but the one invariable and most important symptom is sleeplessness. The tongue is generally pale and flabby, as well as coated with a whitish fur, and is never dry. The appetite is bad, the breath often fœtid, and the bowels confined. The pulse may be quick, though soft and powerless. The skin is always moist, and at times bathed in perspiration. With these symptoms the characteristic delirium with trembling is not far off. It may, however, in surgical practice set in suddenly without warning.

Its characteristics.

Delirium and tremor.

The nature of the delirium is very characteristic, and is always accompanied by illusions which are generally spectral. The patient sees objects that do not exist, and hears sounds that are imaginary; these being always of a strange or frightful nature. At times some delusion as to business or home matters agitates the mind. These same unsound ideas are sometimes fixed during the whole attack; but more commonly succeed one another in rapid rotation. Sleeplessness under these circumstances is a constant accompaniment The patient will be quiet for a time, muttering words without meaning, or, he will be restless and get out of bed in obedience to some imaginary call. He will pull about his bedclothes, will rise up in bed at one moment under one impression, and lie down again under another. If asked to put out his tongue he will do so, but probably with a jerk; if to give his hand, he will project it with a thrust. A nervous trembling of the extremities, with an utter want of control or steadiness of purpose is characteristic. If these symptoms continue, and rest cannot be obtained, prostration of all the powers will rapidly appear, and death supervene from exhaustion or coma. If sleep—sound sleep—can be secured, the symptoms usually mitigate rapidly.

Want of sleep.

Prostration.

Prognosis.

The *prognosis* must depend on several considerations. If the patient be young and the attack ensue after a short period of drinking, the chances of recovery are hopeful, but if the attack occur in a man of middle age, habituated to over-drinking, and if his liver or kidneys be unsound, it is fraught with much greater danger. If the attack be associated, moreover, with an injury, such as a wound or fracture, another element of danger is introduced. The best guide to the patient's real condition is the study of the pulse, not merely as to the number of its beats, but with regard to its character. The sphygmograph is of great service in such cases, as by its help a "dicrotic" state of pulse is often shown where the finger would not indicate it, and such a condition is a bad omen. The most frequent complication is pneumonia, which often comes on rapidly and insidiously,

and is a frequent cause of speedy death even when the excitement has subsided.

Treatment. TREATMENT.—This disease essentially being one of depression of the nervous system associated with sleeplessness, the main object of the surgeon is to induce sleep, to calm the excited brain, and to give it time to recover its normal functions; and with this end, absolute quiet and the use of bland and nutritious food are most essential.

Food. Easily digested, nutritious food must be administered when it can be taken by the mouth, but when refused or rejected, resort must be had to enemata. Milk is, undoubtedly, the most suitable form of nourishment, either alone or mixed with eggs, but it does not suit all stomachs. The question of giving stimulants, and to what extent, is one of great importance. As a rule, the less given, the better, but in some cases it is advisable to give them, and that form of alcohol to which the patient has been accustomed is the best. Young men with an acute attack may do well without any, but in other cases, the feeble powers of the patient require some such aid to stand against the exhaustion caused by the restlessness and excitement. The chief reliance, however, should be placed on other forms of food, such as strong animal broths, Darby's fluid meat, or similar preparations.

Stimulants.

Opiates. Opium, in one of its forms, is a drug still in favour, although some reject its use altogether, and trust to feeding and time; relying upon the knowledge, that the disease has a natural tendency to terminate in sleep after the second or third day. In an ordinary case of the disease, one grain may be given as a dose, or mxx of the tincture, repeated every three or four hours or oftener, till sleep is procured. In other cases two or three grains may be given at once, and followed by grain or half-grain doses.

The best method of administering drugs in this disease, however, is by subcutaneous injection, and I recommend the injection of morphia in solution in doses of a quarter or half a grain in preference to any other plan; because the condition of the stomach of patients suffering from the disease is far from satisfactory either for absorption or assimilation, and, by the hypodermic method of introducing the narcotic into the system, its absorption is more certain and rapid. In some cases the beneficial influence of morphia thus employed is very remarkable, and only in exceptional instances the treatment fails.

The use of chloroform has also been urged, though such a plan is not devoid of danger and can hardly be advised except for some temporary purpose, such as to dress a wound, or to enable an enema to be given.

Chloral. The hydrate of chloral is a drug of great value as possessing hypnotic qualities without the evils attendant on other drugs of this class. It may be given in doses of 20 to 40 grains, and repeated, at moderate intervals, till sleep is procured. Drs. Kinnear and Lawson in the Melville Hospital have treated from 70 to 80 cases successfully with large doses of cayenne pepper, from 20 to 80 grains having been given as a dose. Dr. Macleau, of Netley, trusts to quiet and the use, at short intervals, of strong beef tea highly charged with cayenne pepper.

Digitalis. Of late years the value of digitalis has been greatly extolled, but my experience of it has not been favorable. It is given in

large if not poisonous doses; two drachms of the tincture every hour for three or four doses till sleep is produced. It is a dangerous mode of treatment, and cannot be recommended.

Purgatives. When great excitement and some fever exist, antimony in small doses has been much advocated. The condition of the bowels almost always demands attention, as the tongue is usually foul and the secretions morbid. A purge sufficient to empty the colon is consequently of service, but violent purgation is injurious.

Tonics. Tonics, such as quinine and iron, with or without opium, will be required as the disease subsides. The combination of the tincture of iron with the tincture of opium in carefully regulated doses is preferable. In other cases ammonia with bark may be administered.

Question of restraint. With respect to coercive measures in the treatment of these cases, there is no doubt that they ought to be condemned. In exceptional instances, where sufficient help cannot be obtained to prevent the patient from injuring himself or others, the jacket doubtless must be employed, but under no other circumstances is it justifiable. An attendant who combines decision of character and firmness, with a gentle and soothing manner, will almost always succeed in "influencing" the most troublesome patient. He is to *influence* him, however, and not to direct him; for contradiction and the exercise of authority over the subjects of this disease invariably excite opposition.

Chronic intemperance. There are some people who are never drunk, yet are always drinking; in whom the tissues are so weak that under injury they rapidly break up; and under disease show no power of repair. In such it is difficult to induce wounds to heal or show any vigorous action.

The best remedy is to supply such patients with all sorts of nutritious food, to give tonics and a moderate amount of stimulants, and thus endeavour to improve their habits as well as restore them to a more healthy tone.

SHOCK AND COLLAPSE.

Shock. A man receiving unexpectedly some startling news, which excites severe emotion, and dying suddenly, is said to die from shock; a second receives a fatal blow upon the epigastrium; a third is struck dead by lightning, death in each case is said to be due to shock. In all, the heart's action is suddenly arrested through the nerve centres—in one case through the mind, and in the others through the body. Under these circumstances, the heart is found full of blood, distension having paralysed its action.

Collapse. A man receives a severe compound fracture, gunshot or other injury, and is not killed, but collapsed. Another, or possibly a child, is much burned or has a large portion of the integuments of a limb torn away or crushed, in which the peripheral nerves are seriously involved, and, as a result reflex paralysis of the heart occurs. Both have sustained a shock more or less intense, and, as a consequence, become cold and almost, if not quite, pulseless. In either case, the skin appears to be bloodless, and covered with a cold clammy sweat. He may breathe almost imperceptibly, feebly, or with sighs and gasps. His nostrils will, probably, be dilated; his eyes

dull, with vision imperfect; and consciousness may be lost in very variable degrees,—the patient may possibly be roused, yet, as a rule, he requires rousing to prove the existence of consciousness. At other times, the intellect remains quite clear.

Its signs.

These are briefly the signs of collapse, or shock, the result of injury. They are to be found in variable degrees after most accidents, and are by no means usually fatal, unless the injury itself is fatal. Of course, if the shock from the injury is very great, the heart may cease to beat and the lungs to breathe, collapse passing, more or less slowly, into death; but more usually, after a variable period, the heart's action gradually improves, the respiratory act becomes more regular, and perfect colour returns to the bloodless lips and skin, warmth re-appears on the surface of the body, and consciousness becomes more manifest; these symptoms indicate what is known as reaction, and, when they are excessive febrile symptoms may appear. It should be noted, that vomiting is often the first indication of reaction in general collapse, as it is often in that of head injuries. Should the nature of the accident be such that hæmorrhage complicates the case, the collapse will be more lasting, the shock of the accident passing into collapse from hæmorrhage; under such circumstances a fatal result is very likely to ensue (the amount of bleeding and its rapidity determining the result), for it should be known, that hæmorrhage by itself is enough to produce collapse, or syncope, and this, added to the shock of the injury, is often more than enough to destroy life. In abdominal injuries, this combination is well seen, the hæmorrhage from a lacerated liver or other organ, as a rule, appearing with the first manifestations of reaction from the shock of the accident, and thereby proving fatal.

Reaction.

Delayed reaction.

The longer the reaction is delayed, the more grave is the aspect of the case; not unfrequently relapses appear, signs of reaction and of collapse alternating in variable degree, till one or the other asserts itself in recovery or in death.

Mania on reaction.

In rare cases, even from the shock of a slight accident, reaction is followed by exceptional symptoms; thus, I had a man under care who was admitted with a slight concussion of the brain, in whom reaction was attended with an acute attack of maniacal excitement which left him after two days to pass on to a steady convalescence. A woman with a similar injury attended with a scalp wound, had a like attack, which lasted a fortnight and then subsided without any bad results. I have recorded also, in another page, a case of general tetanic spasm which showed itself in the reaction after a case of spinal injury. More commonly, however, reaction is attended with what Travers has described as "prostration with excitement," a state bordering on, and often passing into, that known as delirium tremens.

Tetanus.

Conditions favorable to shock and collapse.

Under some conditions of the system shock and collapse are more readily produced than at others; thus, very young and very old subjects, those enfeebled from age or other cause, mental or physical, are particularly apt to die of shock, after injury or operation. When bones are involved in the injury and symptoms of "shock" appear after a day or two's satisfactory progress, Professor Nussbaum believes them to be due to fat embolism as evidenced by severe dyspnœa, œdema of lungs, and sudden death. Patients with bad kidneys, also, are very liable to suffer from shock, and to succumb to any operation, however

Albuminuria and shock after operation.

trivial. Surgeons see this at times in the sinking after small operations. Thus, I lost some years ago, after the removal of a fatty tumour, a woman of middle age, simply from asthenia; the operation having been unattended by any loss of blood; also a child, æt. 8, after some operation on a cicatrix of the neck, in the same way. In both, bad kidneys were found after death. The idiosyncrasy of the individual has also a powerful influence on "shock."

Treatment. TREATMENT.—Shock or collapse uncomplicated with hæmorrhage may be treated in one way; shock or collapse, the consequence of, or combined with hæmorrhage, in another.

In both cases the heart's action must be either excited or maintained; "the heart must beat, and the patient must breathe," or life will fail. Even in the worst cases, as long as any signs of life exist, the respiratory process may be aided by artificial respiration, and the warmth of the body kept up by external applications. Savory, in an able article ('Holmes's System,' Ed. 2, vol. i), advises as the result of experiment and reasoning that, should no evidence of the heart's action Venesection be detected, and no hæmorrhage complicate the case, a vein should be opened—as the external jugular—in order that the over distended heart may resume its action as soon as it is relieved from its paralysis by distension.

Transfusion. In the extreme collapse following hæmorrhage transfusion is also "a fair and rational expedient."

In less severe examples the surgeon's object should be to keep the patient alive, but he ought not to try to do more; as to force nature is always injurious, and sometimes fatal. The failing powers of a feeble subject may be excited to act only to give way again, they may not a second time respond to the former stimulant.

A too rapid reaction may so stimulate the heart as to set up a fatal hæmorrhage, when, by the collapse, the wounded artery might have become sealed by nature's own blood-clot.

In all cases of shock and collapse, therefore, complicated with local injury, great judgment is called for. To do enough to maintain life is essential, but to do more is injurious.

Posture. The horizontal position under all circumstances should be observed,
External warmth. and external warmth secured by means of blankets, and hot flannels applied to the pit of the stomach. Sir J. Simpson's plan of applying heat to the body is very beneficial, by filling six or eight soda-water bottles with boiling water and tightly corking them, and then drawing over each a woollen stocking wrung out of hot water. The bottles so Stimulants. covered, were then packed around the patient in bed. Stimulants in carefully adjusted quantities may be given, and brandy is the best. This should be given in small quantities, and if the heart's action fail to respond to its administration after two ounces or so have been swallowed, more is of little service, the stomach usually rejecting it. When the stomach rejects brandy, or the patient cannot swallow, an enema of brandy in warm starch, milk, or gruel, sometimes acts very rapidly. As soon Food. as the heart's action is established, liquid food, such as warm milk, may be given, though only in small quantities, and the case should be carefully watched; food and stimulants should be given with discretion and as the symptoms indicate, the greater the loss of blood the greater being the necessity for food.

Remedies for excessive reaction. Excess of reaction is to be checked by soothing remedies, opium in

any of its forms, henbane, and chloral, are also very valuable, a few hours' calm sleep generally acting like a charm, yet when brain complication appears this treatment is to be adopted with care. Anything like coma contra-indicates it.

Amputation in collapse.

In compound fractures and other local injuries demanding operation, it is an important question to decide, as to the wisdom of operating on a patient in a state of shock. Can the operation act as a stimulant, and tend to rouse him? or may it act as a second shock, and tend the other way? When the shock is severe, and the patient almost pulseless, it is doubtless the wiser plan to postpone all operative interference till the heart's action is re-established. To amputate a limb under extreme collapse is to destroy what chance of life exists, or to do an unnecessary operation. To amputate when reaction has set in after the lapse of a few hours, when external warmth, stimulants, and tonics have had their influence, is likely to prove successful.

When permissible.

In less severe examples of collapse, however, the same practice does not seem to be necessary, especially when hæmorrhage has been the partial cause, and is still continuing, because when collapse is present, the loss of very little extra blood by oozing forbids any hope of a good reaction being established, and thus no benefit can be acquired by delay, but only harm. The administration of chloroform has, moreover, a stimulating influence upon the heart and nervous system, which is often very valuable. I have frequently performed primary amputation upon subjects in a state of partial collapse after injury under these circumstances, and have never regretted it. With a patient in a state of collapse no amputation should, however, be performed, when, by delay, no harm can accrue. When hæmorrhage, however trivial, is going on, or is likely to recur at any moment, the surgeon should interfere and remove the part when its removal is essential.

When the collapse is associated with semi-consciousness, chloroform is not needed, the operation itself acting as a sufficient stimulant; but when the mind is clear as to what is going on, its use should not be withheld, because although it is true its secondary effects are sometimes depressing, and may be injurious, in a general way it has a beneficial influence, tending to prevent a second shock, both mentally and physically.

When extreme collapse exists.

When collapse is extreme.

"How far," writes Savory, "the patient should be allowed to rally, and when he has reached that state which will enable him to bear the operation, are, of course, questions which cannot be answered in a general manner, but which must be decided by the surgeon in each case."

Where the surgeon is in doubt about acting, he had better decide in favour of delay. When no doubt exists as to the wisdom of removing an injured part, and by delay harm must or may probably ensue, he should act at once, even when the patient has not quite rallied from the shock of the injury. When, so far as the local injury is concerned, the delay of a few days or hours is unimportant, all operative interference should be postponed.

In severe compound fractures, gunshot or otherwise, hæmorrhage is almost sure to occur as soon as reaction appears, and the shock of the removal of a limb is not so much to be dreaded as the loss of blood.

"Wounds of the largo arteries of the legs and arms from balls and shells always bleed more or less at the time of reception, and more freely as the shock to the nervous system passes off and reaction comes on. Even when this nervous shock is not sufficient to produce immediate death, the chances of ultimate recovery must frequently turn on the mere question of loss of blood." (Hammond, U.S.)

In military practice, primary amputation upon the field is now generally preferred to secondary, and, in civil practice, a like rule should generally be enforced.

Summary. To perform any capital operation on a patient in a condition of extreme collapse or shock is bad practice. To do so, however, when a minor degree exists, and the pulse can be felt, when, by delay, other dangers are to be expected such as continued or renewed hæmorrhage, is sound and good surgery. To an unconscious or only slightly conscious patient, chloroform is not necessary. To the conscious it has often a beneficial action, and tends towards the encouragement of reaction.

FEIGNED AND HYSTERICAL OR MIMICKED DISEASE.

Feigned disease and hysteria contrasted. I have placed these two classes of cases together for purposes of convenience, and in this section as they are essentially diseases of the nervous system. Both, in a measure, and with different degrees of accuracy, simulate real or organic disease, while feigned disease is a deception, and hysterical a reality. In the *former* the will of the patient is strong to deceive, it is bent to simulate the symptoms of an affection of which the individual knows something, though not all, and from this, the full knowledge of the surgeon or physician is to override the imperfect knowledge of the impostor and to expose him. In the *latter* the will of the patient is weak; functional derangement is allowed to assume the garb of organic disease; subjective symptoms are intensified, not, however, from motives of deception, but from a want of the controlling influence of health more particularly of the nervous centres, a condition of hyperæsthesia commonly existing from some imperfect nutrition of the nervous centres. In exceptional cases anæsthesia is present, more particularly in the larynx.

Feigned disease is a voluntary deception from beginning to end, and is unreal. Hysterical disease is an involuntary exaggeration of some functional derangement, "an unwilling imitation of organic disease," and real.

General remarks on feigned disease. *Feigned affections* are met with chiefly in the intellectually weak, or those of crafty character, and, in a general point of view are attended with an exaggeration of symptoms far beyond those met with in real or organic disease; pain is said to be far more intense than is usually met with, and paralysis more complete; every symptom simulated is extreme; inconsistencies are present which are not reconcilable with those symptoms usually met with in the disease simulated, and these inconsistencies and exaggerations should always excite suspicion in the mind of the practitioner, causing him to test quietly every symptom or group of symptoms, and to doubt his diagnosis until he has proved its truth.

Subjective symptoms. To the *subjective* symptoms, or those complained of by the patient, these remarks are very applicable; but to the *objective*, or those palpable to the observer, they are so to a degree. The subjective symptoms are

always exaggerated, the objective inconsistent; the former being too bad for truth, the latter inconsistent with experience. For example, the rigor of an agne may be simulated, while the hot and the sweating stage is impossible. Epileptic convulsions, catalepsy, or madness, may uudoubtedly be imitated; bnt in all these, there will be, when present, some exaggeration or inconsistency not fonnd in the real disease. Paralysis can also be readily simnlated, bnt it will, probably, be too complete; it will, on testing, more particularly when doue unexpectedly, be associated with a greater degree of sensibility in the skin than is usually present. Wheu of long standing it will not be attended with the nsual wasting. Vomiting, conghing, or spitting of blood can be artificially prodnced, though nnder these circumstances the severity of the symptom will, probably, contrast strangely with the mildness of any others with which it may be atteuded. Objective.

In fact, in feigned diseases, on a careful investigation into the history of the case, the succession of symptoms, their progress, intensity, and duration, some element will be brought out which is irreconcilable with truth, some suspicion that deception is at work will be excited, which, if worked out, must nnmask the imposture and prevent error.

The subjects of *hysterical disease or of nervous mimicry* are mostly what is called nervous and emotioual. They have commonly "a very unusual mental character: in the majority, there is something, notably, good or bad, higher or lower, than the average—something outstanding or sunken."—PAGET. In this affection "every part of the body may become, under provocation, the seat of an apparent disease that in reality does not exist, it may, and often does, assume all the attributes of reality with an exactness of imitation which nothing short of careful and accurate diagnosis can distinguish from the real disease."—SKEY. In joint and spinal disease, the truth of this is most frequently seen, Brodie having stated "that among the higher classes of society at least four fifths of the female patients who are commonly snpposed to labour under diseases of the joints labour nuder hysteria." On hysteria.

How, then, it may well be asked, is the hysterical affection to be made ont from the real? How is the surgeon to avoid falling into the error of treating some functional derangement as organic disease? Diagnosis.

In a general sense, it may with truth be laid down, that in hysterical affection of a part, local pain and sensitiveness on manipulation, are always great, and bear no relation to the amonnt of changes visible or to be detected in the part. The slightest touch excites pain, which probably a bold one fails to do; the pain too rarely, if ever, follows the anatomical course of any nerve or nerves, and the onset of the symptoms is generally more sudden and severe than that usually ushering in organic affections. Febrile distnrbance or increase of temperature, moreover, rarely complicates the case however severe the local symptoms may be, and the nervous "distnrbance very rarely takes the form in which morbid nervous influence produces, not mimic, but real organic changes."—PAGET. In fact, all the subjective symptoms are much more severe than the objective, the latter being either very slightly marked or non-existing. For example, a girl is snddenly seized with severe and lasting pain in the hip, knee, or other joint, aggravated by movement or the slightest tonch, and yet no visible alteration in its outline or structure can be detected, even after the lapse of many

months. Another is as suddenly affected with spinal affection, as indicated by local pain in the back, inability to stand, &c. &e., without any local evidence of organic disease. A third suddenly finds herself unable to flex or extend a limb, and the slightest force excites severe muscular spasm and pain. A fourth is attacked, without a cause, with some muscular spasm, possibly involving a finger or fingers—a spasm that resists all attempts at extension. A fifth suddenly loses sensation or the power of motion in some part of a limb, quite irrespective of nerve supply. In these cases, again, however severe the pain may be during the day, it is rarely felt at night. Such patients, as a rule, sleep well and quietly. During sleep, also, it often happens that joints which are immovable by day are found to be more flexed or extended. Patients with supposed diseased spine are found on their sides coiled up in a natural attitude. As an aid to diagnosis, the value of some anæsthetic cannot be too highly praised, as with a patient under its influence, rigid parts rapidly yield, rigidity of muscle returning only with consciousness, and those parts supposed to be paralysed often move, suspected joint disease disappearing by a close examination where previously doubt existed.

Value of Anæsthetics.

Hysterical disease is more commonly met with in female than in male subjects, in single than in married, in those whose nervous systems have been unstrung from some mental or physical trial, or where the emotional centres are inadequately balanced by the higher controlling ganglia. It is characterised by the suddenness of its attack and the severity of all its subjective symptoms, neither the clinical history of the case nor the objective symptoms present being consistent with those usually met with in organic disease; the exaggeration of certain symptoms and the absence of others, coupled with the anomalies of its nature, mark the hysterical affection over the organic, and are sufficient to excite a doubt as to the true nature of the affection.

For valuable information on this subject, the reader may be referred to the lectures of Brodie, Skey, and Paget, Russell Reynolds' Essay on hysteria, and Anstie's lectures in 'Lancet.'

CHAPTER VII.

INJURIES AND DISEASES OF THE SPINE, &c.

Spina bifida.

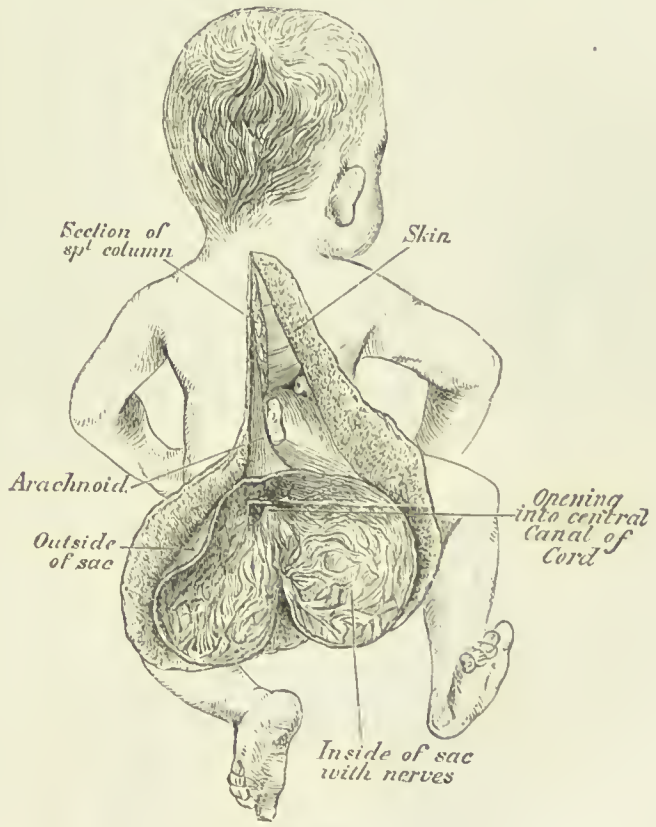
Description.

A spina bifida is essentially a hernia of the membranes of the cord through an opening in the spine, due to a congenital deficiency, from arrest of development, in some portion of the bones forming the spinal column. It is analogous to the meningoceles of the cranium which have been already described. It always contains subarachnoid fluid, and often the spinal cord itself, or, large nerve trunks. Mr. Hewett believes, that when the fluid has collected in the subarachnoid space, or between the cord and the membranes, the cord is pressed; and that when fluid alone is present, the collection is situated in the cavity of the arachnoid. Mr. Hutchinson has recorded ('Path. Trans.,' vol. viii) a case in which the serous sac in the cauda equina had a direct tubular communication with the cerebral ventricles; and in the specimen figured on p. 257 (Fig. 75), taken from a dissection kindly made for me by Dr. Pye

Smith, there was a funnel-shaped opening, leading from the tumour into the persistent central canal of the cord, the nerves being spread out under the internal lining of the sac, and thus forming one of the layers of its wall.

The spinal hernia is sometimes covered by the whole thickness of integument; at others, the integument, though present, is very thin; while occasionally the walls are represented only by a transparent membrane. This last condition was present in ten out of twenty-seven consecutive cases that have fallen under my care. The tumour may have a broad base and free communication with the spinal canal, or a narrow and more or less pedunculated one. Under the former circumstances, the probabilities Characters of the tumour.

Fig. 75.



Dissection of spina bifida.

of the cord being directly involved are greater than under the latter. The tumour is always more or less globular, tense, and elastic. When the child is asleep or quiet, the swelling may be soft; but when the child cries, the tumour will rapidly fill out. The edges of the bony orifice are occasionally to be felt.

The integument is, in some instances, ulcerated even at birth; while in others there will be a small opening in the walls, through which the serous spinal fluid exudes. A nævus is by no means rarely found situated over the tumour. May ulcerate.

Associated with hydrocephalus.

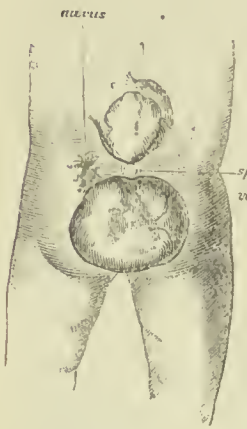
The tumour is often associated with hydrocephalus, and in exceptional instances is double (Fig. 76). Such complications as club-foot or paralysis of the lower limbs, frequently coexist with it, and under such circumstances, it is tolerably certain that the cord is included in the hernia; possibly the nature of the deformity may have been determined by the special nerves which are involved. Paralytic symptoms are more common in the broad-based hernia than in the narrow. Incontinence of urine or of fæces may coexist with the paralysis, or be independent of it.

Paralysis.

Site of lesion.

The lumbo-sacral portion of the column is more frequently affected than any other; but the cervical, and dorsal, portions are also liable to the defect. Thus, in twenty-seven examples which came consecutively under my care, thirteen occurred in the lumbar region, four in the lumbo-sacral, and nine in the sacral. One was double, a small tumour being in the lumbar and a large one in the sacral region (Fig. 76). Twelve of these cases were uncomplicated with any paralysis or deformity. In eleven there was incontinence of urine and fæces, associated in four with paralysis of the lower extremities. Four were complicated with hydrocephalus, two with nævus, and one with talipes. I have seen but two examples in which the tumour was in the cervical region. When the tumour is complicated with hydrocephalus, fluctuation may often be felt between the two parts, pressure on the head causing a fulness of the spinal hernia, and, *vice versâ*. In exceptional cases, the spinal hernia may protrude on the anterior part of the spine.

Fig. 76.



Double spina bifida, from Eliza F—, æt. 3 months.

Diagnosis.

Diagnosis.—In a general way there is no difficulty in diagnosing a spina bifida. In any infant a congenital tumour over the spine is probably a spina bifida; if globular and tense, or capable of becoming tense when the child cries, the probabilities are almost converted into a certainty, inasmuch as the only cases for which this affection is liable to be mistaken are congenital tumours unconnected with the spine—cystic, fibrous, fatty, or fœtal tumours. These may be hard and tense, but they are rarely, if ever, made so much more tense from the child crying as is the spinal hernia.

Prognosis.

Prognosis.—The majority of these cases prove fatal. Many of the subjects are ill-developed, and die within a few days of birth; death from convulsions is very usual when the sac bursts and its fluid contents escape, more particularly when the escape is rapid. The rupture of the sac is not, however, necessarily followed by this result. I have watched a child with this affection for four years, in which at birth the tumour was transparent and soon burst, and, although it discharged at intervals for three years, it has now gradually contracted up into a solid mass. This case is an example of a natural cure, which takes place by the gradual approximation of the bony walls and closure of the orifice of the

Natural cure.

hernial sac. The more pedunculated the tumour, the better the prognosis, so long as no complication exists that threatens life.

Treatment. Treatment.—Palliative treatment is all that can be adopted in the majority, although in exceptional instances operative interference promises to be of service. The tumour must always be guarded from injury by some soft protective material, such as cotton wool or spongio-piline. Slight pressure sufficient to prevent rapid increase of the tumour is also beneficial, and the best method of applying it is, by a casing of gutta percha or felt, moulded to the part. The application of collodion is sometimes useful.

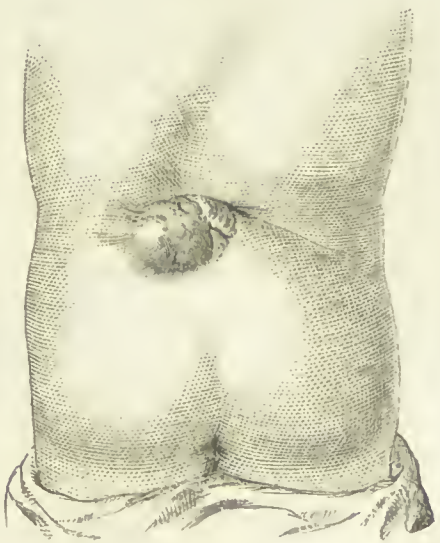
Palliative.

Tapping. Successful cases are recorded in which tapping of the hernia has been performed. The practice, however, is dangerous, as the drawing off of the fluid has been followed by convulsions and even death. Nevertheless, it is the least formidable form of practice that can be undertaken, and should always be employed before more active treatment is resorted to, if only as a preliminary measure. The puncture should always be made at the side of the tumour, for the cord when present is probably placed in the median line. The whole of the fluid should never be drawn off.

Not to draw off all fluid.

Case cured by tapping. Fig. 77 represents a case cured by puncture. It occurred in the person of a man, æt. 26, who came under my care at Guy's Hospital in 1874, for some ulceration of his left foot, which, with the left lower extremity, was wasted from infantile paralysis. He had also a lateral curvature of the spine towards the right side, and a cured spina bifida in the lumbar region. I discovered from the patient that he had been treated for the spina bifida by Mr. W. E. Image, of Bury St. Edmund's, who, in answer to a note, kindly sent me the following account of the case.

Fig. 77



Cured spina bifida, taken from man æt. 26.

"The child was brought to me when about two years old, because the tumour was increasing in size and convulsions were produced when-

ever any pressure was applied to the tumour, even from the weight of the body when placed in the supine position. The tumour was large and semi-transparent. I punctured it obliquely with a darning needle at intervals of two or three days, four or six times, and applied a compress of lint by means of strapping over the tumour. After this the fluid was not again secreted, the convulsions ceased, and the case got well." At the present time, a hard puckered tumour alone exists to indicate the affection. A model of the case may now be found in Guy's Museum.

Injections. Mr. Holmes speaks somewhat favorably of the practice by injection, and believes it to be often harmless. When performed, the fluid should only be partially withdrawn, and four or five drops of the tincture of iodine diluted with a drachm of water injected. The strength of the injection may be increased on each occasion, the object being to excite a slow process of inflammation in the cyst. In no case where the base or neck of the tumour is large, nor in others in which it is evident the cord is implicated, or large nerve trunks are involved, should this or any other operation be performed. In pedunculated tumours it may be attempted.

When unadvisable.

Morton's Iodo-glycerine solution. Dr. Ross Watt, of Ayr, N.B., has recorded ('Brit. Med. Journ.,' April, 1873, Jan., 1874) two successful cases in which he injected at intervals of seven or ten days half a drachm of Dr. Morton's solution made by dissolving ten grains of iodine and thirty grains of iodine of potassium in an ounce of glycerine. The injection was thrown into the sac after the withdrawal of the spinal fluid. Dr. Morton had had some good results by the same treatment.

Excision. With respect to the *excision* of the tumour, a successful case has been recorded in the 'Path. Soc. Trans.,' vol. xiv, in which Dr. Wilson, of Clay Cross, removed the tumour five days after the closure of its neck by means of a clamp; and, when excision is entertained, this plan is probably the soundest. It should, however, only be thought of when the neck of the tumour is narrow, and there is no paralysis of the lower limbs or incontinence of fæces or urine. In all broad-based tumours associated with paralysis, operative measures are out of the question.

Exceptional cases are on record of recovery, after every form of practice, but, on the whole, the results of treatment are not very encouraging.

Sacral and Coccygeal Tumours.

Characters. Congenital tumours are by no means unfrequent in the neighbourhood of the coccyx or sacrum. They are sometimes composed of cysts, occasionally of fat or fibre tissue, and also of fœtal remains. They are generally central. Many of these have, doubtless, been described as false spina bifida, and, in rare examples, there is reason to believe they are cured cases of spina bifida, the sac of the hernia having been occluded at its neck by the natural contraction of the surrounding parts. I have seen one such case in an adult where the tumour was successfully excised. Mr. Pollock has recorded in the eighth volume of the 'Path. Trans.' an example of a congenital fatty tumour which he successfully removed from the central lumbar region of a child æt. 7; and, Mr. Athol Johnson, in the same volume, a rare case of fatty tumour clearly developed in the spinal canal.

Their nature.

Examples.

itself. I have had occasion to remove a large congenital sebaceous cyst placed between the anus and coccyx from a child æt. 10; and from another child, a tumour containing fœtal remains, situated between the sacrum and the bowel. I may further refer to a third interesting case of cystic tumour of the sacrum, possibly spina bifida, in which the cyst burst, and complete recovery followed. The following are the brief notes of the two latter cases.

Notes of cases successfully treated.

Marie B—, æt. seven weeks, was brought to me in 1868 with a congenital tumour the size of a large orange projecting from between the bowel and coccyx, and apparently passing up in front of the bone (Fig. 78). It had been growing rapidly since birth, and was pressing upon the bowel, though the child in all other respects was healthy. I excised the growth, and found that microscopically it was made up of fat, fibro-cellular tissue, mucous membrane, cartilage, and bone elements. Recovery ensued and the child has kept well.

A male child, two days old, was brought to me on July 30th, 1868, with a large cystic tumour covering in the lower half of the sacrum and occupying the perinæum (Fig. 79). It was the size of a cocoa nut, and transparent as a spina bifida, yet in all other respects the child was well formed. The next day it burst and many ounces of a blood-stained fluid escaped. The sac collapsed, but no evil result followed this bursting of the cyst. I watched the child for many months, and, on November 30th, 1871, the tumour had contracted up to an irregular indurated mass of integument. The child was very healthy.

Treatment. Excision.

Treatment.—The only right treatment is the excision of the growth, which should be the general practice unless symptoms exist to contra-indicate any surgical interference, such as extensive or dangerous connections of the tumour. Care should always be taken to

Fig. 78.



Fig. 79.



Congenital coccygeal tumours.

ascertain that no communication exists between the tumour and the spinal canal.

Hewett, 'Med. Gaz.,' vol. xxxiv.—*Behrend*, 'Journ. f. Kinderkrankheiten,' vol. xxxi,—*Nélaton*, 'Path. Chir.,' vol. ii.—*Holmes*, 'Surgical Treatment of Children's Diseases,' 1869.

INJURIES OF THE SPINE, CONCUSSION, &c.

General remarks.

The spine is a flexible tubular column composed of ring bones, alternating with a dense elastic intervertebral substance. These bones articulate by means of joints, and are bound together by strong yet elastic ligaments. From the upper orifice of the tube the spinal cord with its membranes is suspended in a chamber filled with cerebro-spinal fluid, and surrounded by large venous plexuses. The cord and its membranes are held in position by the nerve-trunks that pass with the processes of dura mater that accompany them outwards between the bones.

Local spinal injury.

A local injury to the spine, such as a forcible bend forwards, may sprain or lacerate the ligaments that hold the bones in position. A still more forcible bend may crush the bodies of the vertebræ that form the anterior portion of each ring. If the force be still continued upon the broken bones, displacement may take place, when the delicate cord itself will either be slightly pinched between the displaced bones and contused, or completely crushed or divided. In the cervical and lumbar regions, the bones may be dislocated, the amount of injury to the cord depending entirely upon the amount of displacement that has taken place. When such displacement is very slight, the cord may be uninjured. Sprains of the back may also, at a later period, be followed by disease both of the joints and bones of the spine.

Diffused injury.

A diffused injury to the spine, such as that caused by a fall from a height upon the back, or by a heavy falling body, or a severe shaking as from a railway accident, may produce some fracture or dislocation of the bones of the spine, but it must to a certainty cause a severe shaking or concussion of the spinal cord itself, as manifested by a more or less complete suspension of all the functions of the cord, either for a short period or for life. This concussion of the spine may be accompanied by hæmorrhage into or upon the cord, giving rise to compression, or may be followed by acute or chronic intra-spinal inflammation, terminating in paralysis and death.

Gravity of case dependent on amount of lesion to cord.

In *both local and diffused injuries of the spine the gravity of the case depends chiefly upon the amount of injury the cord has sustained;* a severe local injury to the osseous part of the spine can be completely repaired without danger to life, whilst any injury to the cord and its membranes is fraught with danger, either directly by suddenly arresting the functions of the parts to which the injured nerves are distributed, or, indirectly by setting up chronic inflammatory changes in the cord.

Concussion of spine.

When the functions of the cord have been directly suspended by any local or diffused injury to the spine, the patient is said to have suffered from *concussion of the spine.* Should the symptoms be complete and persistent, there is good reason to believe that the cord has been crushed by some displacement of a fractured or dislocated bone. Should some interval of time have taken place between the receipt of the accident and the paralysis, there is a fair suspicion that the paralysis is the result of some hæmorrhage into or around the cord. Should the paralytic symptoms have followed the accident after a few days, and be attended with constitutional disturbance or spasm of the muscles of the limbs, the cause of the paralysis was probably some inflammation of the cord and its membranes; and, should the paralysis have been of a slow and progressive nature, the probabilities are that it is the consequence of some chronic softening of the cord; because all these different results have followed local and diffused injuries to the spine,

Persistent paralysis.

moreover it is the knowledge that they may take place which renders any spinal injury a matter of importance, both as regards the immediate effects of the injury and its secondary consequences.

Tetanus after spinal concussion.

In rare instances, symptoms similar to tetanus follow spinal injury. I have seen such in two cases. One was that of a man, æt. 35, who fell from a height on his head, bending the neck forward. He was paralysed for a few hours from the neck downwards, and, on the appearance of reaction, had marked tetanic symptoms with the contracted brow and risus sardonicus. Spasms could be excited on the slightest touch being applied to his neck. In twelve hours, however, all these symptoms disappeared, and recovery ensued.

In the second case, a man received a crush in the loins, between two carts. Lock-jaw followed, with general spasms of all the muscles of the body. In five hours the spasms subsided, but they were followed for five days by hyperæsthesia of the integument, and, on the sixth day, by weakness of one leg. In a month he was convalescent.

Analogy between spinal and cerebral injuries.

In former chapters it was shown that the functions of the brain may for a time be interfered with or suspended by a simple shake or concussion of its substance; that a severe concussion may give rise to contusion of the brain, either at the seat of injury or on the opposite side by contre-coup; that extravasation of blood either upon the surface of the brain or within its structure may follow such an injury; that fractures of the skull are of importance in proportion to the severity of the intra-cranial complications; and that intra-cephalic inflammation is too frequently the result of any head injury. In injuries to the spinal column and its contents similar results have to be recorded. A *simple concussion* of the spine may produce a partial or complete suspension of the functions of the cord; yet by rest and quiet these symptoms may disappear, and a perfect recovery follow. A *more severe concussion* may give rise to some injury of the nervous structure; to some extravasation of blood upon or into the cord itself. Such a complication will necessarily be associated with more marked symptoms, more complete and persistent paralysis and anæsthesia of that portion of the body supplied with nerves from the injured centre; the completeness and persistency of the paralysis and anæsthesia depending upon the severity of the mischief, and, on the seat of injury. When the paralysis is severe but *incomplete*, there will be retention of urine, this symptom arising from the loss of voluntary power over the muscles that regulate micturition. But, when the paralysis and anæsthesia are *complete*, there will be absolute paralysis of the bladder and all its muscles, with incontinence of urine. This incontinence, however, must not be confused with the dribbling of an over-distended viscus from retention, such as occasionally occurs in the less severe cases.

Simple concussion.

Severe concussion.

Complete or incomplete paralysis.

Symptoms according to regions injured.

When the injury is in the cervical region, one or both arms may be more or less paralysed; when in the lower dorsal, one or both legs; but, as a rule, the paralysis is symmetrical and the symptoms depend on the nerves that are involved. The loss of sensation is also generally complete. In one case, however, there may be paralysis of one limb and loss of sensation of the other; in a second, exalted sensibility with paralysis. In one, the power of motion may be regained, while that of sensation remains lost, and in another the reverse; indeed, on these points there is every possible variety, the seat of injury clearly determining the nature of the paralysis.

Brown-Séquard's observations on injuries to cord.

Brown-Séquard's observations and experiments on the decussation of the motor and sensory fibres of the cord, have done much towards the elucidation of these points, and it may now with some confidence be asserted, that when one antero-lateral column of the cord is divided or irreparably injured there must be motor paralysis of the same side of the body below the seat of injury, and loss of sensation upon the opposite side of the body—the motor paralysis being due to the destruction of the white substance, and the loss of sensation to that of the grey.

When any portion of the white substance is left intact, some motion will remain, and, when any part of the grey is uninjured, some sensation. Complete division of the cord is necessarily followed by complete paralysis and loss of sensation in the parts below, although by what is called reflex action, the muscles of the parts may be made to contract on the application of any stimulant, such as tickling, to the sensory nerves.

Pain in the course of a sensory nerve, or in an extremity, is to be taken as representing the irritation of the cord or nerve at its central origin, and, in cases of fracture, as the spot where the bone has been broken. Symmetrical pains mean central mischief, uniateral pains local.

Cervical.

A severe blow upon the upper cervical region may produce according to Erichsen instantaneous death from concussion. When the *vagus* nerve is affected, a sense of suffocation, with irregular action of the heart, or constant vomiting, may be produced. When the *spinal accessory* is injured, spasm of the trapezius or sterno-mastoid muscles occur; and irritation of the *phrenic nerve* causes hiccup, as well as the sensation of an iron band-like constriction round the body. When the injury is in the lumbar region the paralysis is always partial, as the cord terminates at the second lumbar vertebra.

Lumbar.

Temperature of paralysed side.

The *temperature* of the paralysed limb is always lowerthan the rest of the body, even when to the patient it may feel hot orburning.

Prognosis.

The *prognosis* in any case of concussion of the spine depends entirely upon the changes that are produced in the cord by the injury; and these are fairly to be measured by the severity of the symptoms and their *persistency*. This latter guide is very reliable, the persistency of symptoms being generally indicative of organic change. Again, when organic change has taken place there is thegreater probability of some secondary inflammatory action in the injured part, and on this the prospects of the case hinge; for in injuries to the spinal cord or membranes, as in injuries to the brain, this intracephalic or intra-spinal inflammation is the cause of dangr or of death in every case that survives the immediate effects of the accident, while it leaves, even when life is spared, more or less complete paralysis of the parts below the seat of injury.

Depends on persistence of symptoms.

INTRA-SPINAL INFLAMMATION.—SPINAL PARALYIS AFTER CONCUSSION.—RAILWAY CONCUSSION.

General remarks.

Intra-spinal Inflammation.—"Every injury of thespine should be considered as deserving of minute attention. Inflammation of the cord and its membranes may supervene upon very slight injuries of the

spine; it may advance in a very insidious manner, even after injuries that were of so slight a kind that they attracted at the time little or no attention."

Thus wrote Abercrombie in 1829, and his observations are as true now as they were then. Upon such views, the whole treatment of injuries to the spine, simple or severe, ought always to be based.

The preventive treatment of spinal as of head injuries means the adoption of such measures as experience has proved are most valuable in warding off the accession of intra-spinal and intra-cephalic inflammation, and thus preventing paralysis. The simplest shock or concussion of the spinal cord; the slightest blow upon the spine or sprain of its ligaments; any bruising of the former or laceration of the latter; and, *à fortiori*, any severer lesion, is apt to be followed by an acute or chronic intra-spinal inflammation, and, by changes in the structure of the cord that may give rise to a paralysis, partial or complete. The surgeon has, moreover, no guide by which to measure the danger or calculate the probabilities of the occurrence of this secondary inflammation, since it may follow a slight accident, and fail to follow a severe one. In a general way, the prospects of its appearance and its danger depend much upon the gravity of the injury.

Proneness to secondary inflammation of cord.

When the cord has been much contused or crushed by a fractured or dislocated vertebra, the paralysis that necessarily follows such a lesion is not likely to be aggravated by any secondary inflammatory changes in the injured cord, although the termination of the case may be hastened by these changes. Under such circumstances, the complication is not of such a nature as to add to the surgeon's anxiety. In less severe examples of injury, however, in which the primary symptoms do not indicate any organic lesion beyond that which manifests its presence by some temporary suspension of the functions of the cord, it becomes a matter of primary importance to recognise the very earliest indication of inflammatory action, in order that it may be arrested; for, as it has been shown, that the chief aim in the treatment of all these injuries is, to prevent the occurrence of inflammation, so the second is, to try and arrest its progress as soon as it has appeared. When it has become thoroughly established, neither medical nor surgical art has much power in checking its progress or in correcting its effects; as the delicate structure of the spinal cord appears to be incapable of undergoing material repair when softened by disease or crushed by accident. The cord structure when once destroyed is replaced by means of a fibrous substance. Paralysis or loss of function, under these circumstances, is permanent. In any case, therefore, of spinal injury, when the symptoms are persistent or tend to become worse; when after their partial or complete disappearance for three or four or more days they recur or appear in some altered form; when local pain is increased, and movement of the back is more difficult or distressing; when pain follows the course of the nerve trunks that emanate from the injured spinal centre, and muscular spasm or paralysis is present; and, moreover, when constitutional disturbance or general febrility is present; when any or all of these symptoms, few or many, are found to follow a spinal injury after the first effects of the accident have passed away, the diagnosis of secondary inflammation of the cord may fairly be made, and action taken upon it.

Necessity of recognising earlier symptoms.

Symptoms of spinal inflammation.

Insidious nature of the symptoms.

In general concussions of the spine, more particularly from railway accidents, when, owing to some general shaking of the body, the spinal cerebral, sympathetic, and circulatory systems are all more or less involved, there is an undoubted disposition for a chronic inflammatory change of a most insidious and creeping kind to supervene.

Symptoms often masked.

It is now well known that the primary spinal symptoms are often so mixed up with the general as that they are really masked; and, beyond a general but temporary loss of power and consciousness there is often nothing special by which spinal mischief is manifested. On recovering from the shock of the accident and the mental disturbance, the sufferer often feels no definite injury, no local symptoms; nor is it till after some time has elapsed—the duration of which is also uncertain—that any special symptoms make their appearance.

Symptoms vague and indefinite.

Even then they are, as were their antecedents, vague and indefinite. It will probably be found that the patient has never been himself since the accident; he has been unable to work mentally or physically with the same force or energy that he did previously; is irritable in his manner, and perhaps feeble in his powers. Sleeplessness too has been more complete or common than it was before, and headache with general malaise, now often exists.

Premonitory symptoms.

Some slight unsteadiness of gait is often the first observed symptom, a feeling of heaviness in the limbs, some abnormal sensation, such as that of pins or needles, numbness along the course of a nerve, cramps, perhaps retention of urine; or some evidence, in fact, of want of control or power over the muscular apparatus, and more marked generally in the lower extremities than in the upper. The centres of sensation may, at the same time, show indications of disturbance, either by a state of lessened sensibility, or perhaps by a hyperæsthetic condition. From symptoms such as these the attention of the surgeon is probably arrested. On testing the muscular apparatus thoroughly, it will probably be found, that the patient will be unable to stand steadily on one leg, or, what is a better test, if he place his heels together, he will totter on making the attempt to raise his body on his toes. When asked to stoop to pick up anything from the ground, he will probably bend his knees rather than his back; and walk with a rigid spine. On giving him a small object, such as a pin, he will take it clumsily and with tremor; will fumble at most things with his hands, and stumble at anything that is in his way.

Affection of the muscular system.

Local signs.

On examining the spine some tenderness may be manifested on firm pressure, but probably only in certain places. Percussion on the bones is hardly a fair test; when employed, it should be indirect, through the fingers. Pressure applied to the spine causes at times severe pain, as does any movement; it is the latter condition which induces the rigidity of the spine in walking, before alluded to.

Cerebral signs.

The brain and organs of special sense may likewise be affected, either by over or under sensibility. *Vision* may be imperfect either in one or both eyes; *hearing* may be over-sensitive or defective; *taste* and *touch* may be perverted or lost; and *smell* at times destroyed or morbid. In fact, the whole nervous system, cerebral and spinal, may be disturbed, and its functions more or less damaged.

Progress uncertain.

The course which such cases run is very uncertain, and the prognosis

is, therefore, difficult. When the motor power has been lost from spinal mischief, the best test is galvanism. A healthy muscle supplied from a healthy nerve centre will always contract on the application of the galvanic current. When the nerve centre is so diseased as to cause paralysis, the galvanic current produces no movement—no contraction. This test is beyond the patient's control, and cannot be resisted; it is consequently valuable. Galvanic test.

In interpreting these symptoms, more particularly in a railway case, or in any where the question of damages is involved, it is most important for the surgeon to separate the symptoms of which the patient complains—the *subjective*, from those he can himself perceive—the *objective*. Let him doubt and cross-examine in every way upon each of the former to test their accuracy. He may rely, however, upon the latter, and any positive opinion ought to be based upon these alone. There always hangs a suspicion over the former because self-interest points to making the worst of them. Caution in interpreting symptoms. Subjective and objective symptoms.

All the symptoms, taken as a whole, undoubtedly indicate a chronic or subacute inflammatory change of nerve-tissue, an inflammation of the membranes or of the cord. When they appear as a consequence of a general concussion of the spine, the cord is probably the seat of mischief, its delicate structure being more liable to injury than the tougher membranes, and, consequently, to secondary changes. When they follow some local injury, such as a twist, blow, or forcible bending of the back with laceration of ligaments, the disease in the cord probably is secondary to disease in the membranes, the inflammation of the latter being due to the extension of inflammatory action from the injured part inwards. "Inflammation of the membranes of the cord, as of the brain, is a disease not idiopathic, but proceeding from some cause without." (Wilks.) But, wherever this commences it is progressive, and, in the end, involves all the tissues in its destructive changes. Myelitis. Spinal meningitis.

The pathological changes themselves are tolerably definite. In the cord they put on the appearance of red softening in recent disease, and of white in chronic. The parts are soft and pulpy, the microscope showing them to contain granule-corpuscles and elements of the inflammatory process. The white matter of the cord will appear at times sound, while the grey substance is soft. The disease may be local or more general. In concussion, the latter is the more common condition. When it is in the cervical region, death is rapid, when in the lower dorsal, life may be prolonged for some time. This fact is well illustrated in fracture and dislocation of the spine. Pathological changes.

Treatment.—In all cases of concussion of the spine, simple or severe, *absolute rest* in the horizontal posture is most essential, and, in mild cases, this is probably the only treatment called for; the symptoms, by the observance of this rule, gradually disappear, and the health is restored. The prone position in more severe cases is generally to be preferred to the supine, but the best guide in this matter is the case which the patient experiences. The surgeon, however, must enforce quiet for many days after the disappearance of all symptoms, even in the mildest cases, on account of the primary danger of intra-spinal inflammation; and the period of rest to be enforced must be in proportion to the severity of the symptoms. In cases of railway con- Treatment. Importance of rest.

Of prolonged rest.

enssion, this practice is of primary importance, and I am disposed to attribute the frequent occurrence of obscure railway spinal cases to the non-observance of this rule. It is true that in the majority of cases there are no definite indications of spinal concussion after the accident, though the nature of the accident itself is a sufficient guide to the case. A general shaking of the body means a general concussion of the spine with every other part, and the nerve centres by reason of their structure are most liable to injury. It would be well, therefore, to keep all patients who have been the subjects of such injuries quiet and in repose for several weeks after the accident. By doing this, much mischief would often be avoided.

Cupping, &c.

After concussion, when severe local pain is experienced, relief is often given by the application of a dry cupping glass on either side of the painful part, and the operation may be repeated. In exceptional cases the local extraction of blood may be found of benefit. The ice-bag is a powerful remedy for good when there is much effusion of blood or pain in the part, and, when the symptoms of reaction are too marked.

The diet should be nutritious, but unstimulating, and nothing likely to keep up or cause mental or physical excitement allowed. When recovery of power in the limbs is slow, and no symptoms of secondary inflammation of the cord exist, convalescence is promoted by the application of electricity in one or other of its forms to the enfeebled muscles.

Mercury.

When symptoms of intra-spinal inflammation have appeared, some advocate moxas or setons in addition to the above treatment; and of the two the moxa is, perhaps, preferable. Mercury in one of its forms appears to be a valuable remedy, and the perchloride is, perhaps, the best preparation, given in doses of 1-16th of a grain two or three times a day combined with bark, quinine, or some other vegetable bitter according to the wants of the patient. When mercury is inapplicable, the iodide of potassium should be substituted. Sedatives should be allowed to procure sleep, and the hydrate of chloral seems to be the best, in twenty or thirty grain doses, at bedtime. Should pain be constant, fifteen grains of the same drug may be given twice a day, a double dose being allowed at night. The extract of belladonna in one third of a grain, or half-grain doses, is likewise a valuable sedative. Strychnine is a dangerous drug in spinal disease, at least, in progressive spinal disease. It is a distinct stimulant to the spinal centres, and is, consequently, most injurious as long as any progressive inflammatory action exists. When only the effects of the disease remain and all inflammation has ceased to manifest its presence strychnine may be given. Should general feebleness exist, iron may be given with it; and I know of no nervine tonic so beneficial as the combination of the tincture of the perchloride of iron in doses of fifteen minims, with five minims of the tincture of nux vomica or one or two grains of quinine. Cod-liver oil is a valuable adjunct to all treatment in this as in many other cases.

Iodide of potassium.

Strychnine.

Iron.

Avoid bedsores.

Great care should be observed throughout the treatment of these affections to prevent the occurrence of bedsores. They form very rapidly when spinal paralysis is present. I have seen several instances in which all the soft parts over the bones sloughed, and the spinal canal was opened; while in others the sacral bone may partially exfoliate.

The back should be kept very clean and dry and occasionally sponged with spirit lotion. It should also be protected further by leather strapping, felt plaster, and by cushions of air or water.

When retention of urine complicates the case, the utmost caution is required in passing the catheter. An elastic instrument should be preferred and of a large size, the French vulcanite catheter being the best. The catheter should be kept scrupulously clean.

FRACTURES AND DISLOCATIONS OF THE SPINE—WOUNDS AND SPRAINS.

Fractures and dislocations to be considered together.

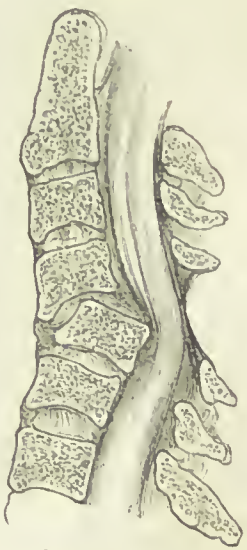
In a practical point of view, it is expedient to consider fractures and dislocations of the spine together. They are not, however, invariably combined, for although in four fifths of the injuries to the spinal column involving the bones some fracture is present, in the remaining one fifth simple dislocation exists. The majority of these cases of pure dislocation occurs in the cervical region; in the dorsal, such an accident is almost impossible, while in the lumbar it is very rare. The difference in the anatomical arrangement of these divisions of the column affords an explanation of these facts. To the practical surgeon these points are, however, of small importance; that which concerns him the most in any injury to the spine has reference to the cord—how much injury has it sustained? Is it reparable or not?

Injury of the cord the main point.

When complete paralysis follows the injury there is little doubt that the cord has been injured. It may be that it has been more or less completely crushed by displaced bone, or even divided. In less severe injuries, less severe symptoms show themselves. Injuries to the cervical region are of greater danger than those of the dorsal, and these again are of more importance than those of the lumbar. The nearer the injury is to the respiratory centre, the greater the danger. Any crushing of the cord above the third cervical vertebra, is, as a rule, followed by instant death; this point being above the origin of the chief respiratory nerve, the phrenic. In cases of injury to the cervical vertebra giving rise to any symptoms of paralysis, death generally takes place within three days, and commonly within two. Thus, out of 36 fatal cases extracted for me by Mr. Rendle from the Guy's Records, 25 died in less than seventy-two hours, and 20 in less than forty-eight; 8 only survived the former period, and in those there were no symptoms of paralysis as an immediate result of the accident. Eleven of the 36 were cases of pure dislocation, 25 were examples of fracture and dislocation combined, and all were below the third cervical vertebra. In every case,

Symptoms, &c., vary according to region.

FIG. 80.



Dislocation of the spine. Guy's Hosp. Mus., No. 1033.

also, of dislocation, the upper vertebra was thrown forward upon the lower, as seen in Fig. 80. Where spinal symptoms resulted, the cord was more or less pressed upon, in some instances crushed, and in others bruised.

Fractures of the dorsal and lumbar vertebræ associated with displacement, and giving rise to paralysis below the seat of injury, are less speedily fatal than those of the cervical region.

Fracture of the spine may, however, take place and not be associated with any paralysis. The spinous processes of any of the vertebræ may be fractured, and no spinal symptoms follow. This accident is generally the result of a direct blow. When I was a dresser I saw a case of fracture of the spinous processes of three cervical vertebræ associated with a temporary paralysis, and in this instance complete recovery ensued; I have since treated successfully a case of fracture and displacement of the spinous process of the fourth cervical vertebra without paralysis.

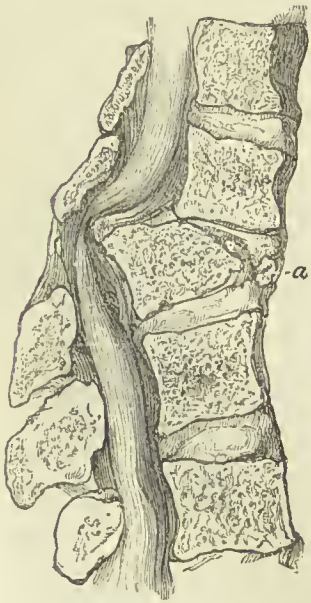
May escape detection.

In other cases, fracture of the spine may take place and not be detected until after death. Examples of this are not uncommon. In such, the cord is not involved nor any of the nerve trunks. The following case illustrates these points. In 1857, a

Example.

woman, in an attack of mania, was admitted into Guy's under the care of Mr. Cock, for some contusion of the back caused by a fall out of a window. Beyond the contusion, no injury could be made out. There was no paralysis, but, on the contrary, violent muscular movement, the patient being maniacal. On one occasion she got out of bed and struggled to open a window to throw herself out. She lived sixteen days, and during the last week of life rested quietly in bed, with her eyes closed. She would only at times rouse herself and speak. After death, atrophy of the brain was found, with general fatty degeneration of the viscera. The last dorsal and three upper lumbar vertebræ were fractured through their bodies, but not displaced; one or two spinous processes were also fractured. The spinal marrow was uninjured. The fact of there being no displacement of the broken bones, and no injury to the cord, prevented a correct diagnosis being made.

Fig. 81.



Fracture of spine.
Guy's Hosp. Mus., No. 1035[25].

I have seen also a case of fracture of the spinous processes of the last dorsal and the first lumbar vertebræ with lateral displacement, the injury having been treated for some months previously, as a simple contusion of the back. In this case no paralysis existed or other spinal symptoms.

Generally the result of indirect forces.

Fractures and dislocations of the spine are generally the result of *indirect forces*, such as severe falls. A forcible bending forward of the cervical spine may cause dislocation

of the cervical vertebræ, and a similar accident to the dorsal spine may cause fracture. In these cases, too, there is always some laceration of the ligaments and crushing of the anterior edges of the bodies of the vertebræ. (*Vide* Fig. 81.) A forcible bending backward of the spine may produce a like result, the laminæ of the dorsal or lumbar vertebræ, under these circumstances, being much broken. Direct violence to the spine in the cervical region may cause dislocation; and in the lower vertebræ it generally causes fracture of the spinous processes or laminæ. Mr. Holmes has recorded in the 'Path. Soc. Trans.,' vol. x, an interesting case of displacement of the last dorsal from the first lumbar vertebra, associated with some slight fracture of the processes, the result of a direct blow.

Fracture of the sternum is not uncommonly associated with injuries to the spine from the forcible bending forward of the head. It was found in four out of fifty-six fatal cases that occurred at Guy's.

Statistics of 56 cases.

Of these fifty-six fatal cases of fracture and dislocation of the spine, thirty-six were of the cervical region, eleven being examples of pure dislocation, eighteen of the dorsal, and two of the lumbar; injuries of the cervical being apparently twice as frequent as those of the dorsal region; the greater mobility of the cervical vertebræ and the obliquely horizontal aspect of their articular processes favouring dislocation.

36 cervical.

In the thirty-six cervical, the injury was below the third vertebra in all but three examples. In one of these, it involved the second, third, and fourth vertebræ; in another, the arch of the atlas and spinous processes of the second and third vertebræ; and, in the third case, the bodies and arches of the third, fourth, and fifth vertebræ.

18 dorsal.

In the eighteen dorsal, seven were in the upper and eleven in the lower half, the lower part of the cervical and of the dorsal regions being clearly more liable to injury than the upper.

When the cord was sufficiently injured in the cases of injury to the cervical region to give rise to paralysis, death generally took place within three days, and, in the majority of instances within two.

When it occurred as a result of injury to the dorsal region, suppuration of the kidneys, cystitis, or bedsores were the most common causes of death.

11 cases of pure dislocation of cervical.

Of the eleven cases of pure dislocation of the cervical vertebræ, four were between the fourth and fifth; two between the fifth and sixth; three between the sixth and seventh; and two between the seventh cervical and the first dorsal. In none of these was there the smallest trace of fracture. In six, the displacement was so great as to crush the cord. In five, there was no displacement and no marked paralysis as a direct result of the injury, although secondary paralysis appeared subsequently, from stretching or other injury to the cord.

In injuries to the cervical region, pure dislocation occurs in thirty per cent. of the cases.

Dislocation of upper cervical.

Cases of sudden death after a fall from a height upon the vertex are doubtless, often due to a fracture or dislocation of the cervical spine. It may be a fracture of the processus dentatus of the axis; a laceration of the transverse ligament binding it in position; or a fracture of the atlas allowing the head to slip forward. Dislocation of the occipital bone from the atlas has been described; it is, however, very rare.

Fracture of odontoid process.

When fracture of the odontoid process takes place, as it may from external violence, or during the progress of some disease in the vertebræ, death, as a rule, occurs suddenly; the victim being literally pithed. In other cases, and these generally of disease, the displacement may be gradual; death being then often preceded by paralysis of an arm or leg, or both, with difficulty in swallowing, pain in the neck, and inability to raise the head into the erect position, or to rotate it.

Vide paper on fractures of the odontoid process, by Dr. Stephen Smith, of New York ('American Journal of Med. Sci.,' Oct., 1871).

Diagnosis.

Diagnosis.—When a patient has received a severe injury to the spinal column followed by complete paralysis, there can be little doubt that the cord has been injured, and that a fracture or dislocation with displacement of the vertebræ has taken place. When the paralysis is partial, it is probable that the cord has been only partially involved, being more or less bruised, or stretched, according to the nature of the accident, and the extent of the displacement of the injured bones. When no paralysis is present the diagnosis is difficult.

When any inequality or irregularity in the spinous processes is present; any pain in one spot aggravated by pressure; any crepitus on manipulation; any local effusion of blood about the spine; any inability to move the spine or support the body; when priapism appears early in the case; when one or more or all of these symptoms come on after such an accident as is liable to produce them, the diagnosis of a fracture or dislocation is tolerably clear.

When paralysis of an arm or leg follows a spinal injury, it is possible that the paralysis may be caused by some partial displacement of the injured bone, by pressure upon one or more of the nerves that pass outward from the spine, or, by laceration of a nerve trunk. When paralysis is incomplete, the motor power is generally more completely lost than that of sensation; indeed, it often happens that there is hyperæsthesia in that portion of the body contiguous to the paralysed part, owing to the portion of cord above the injury being over-active or irritated by the sharp parts of the fractured bone. Intense pain in the line of junction of the paralysed and non-paralysed parts signifies fracture in Mr. Erichsen's opinion. In estimating the seat of injury from the position of the paralysis, it is right to remember that the nerves come off obliquely from the spinal cord and pass downwards, the cervical and dorsal nerve trunks leaving the spine one vertebra or two vertebræ lower than the spot whence they are given off; while the cord terminates at the second lumbar vertebra. Thus, when fracture takes place below the second lumbar vertebra, there may be no paralysis. The patient may be unable to stand or walk wholly or in part, but place him on his back and there will be free movement of his legs. In other cases, the nerve trunks around the cauda equina may be involved.

Increase of temperature.

When a patient has received a severe spinal injury, there may or may not occur what is called "shock;" but when these symptoms have passed off and those of reaction appear, there will commonly in cervical injuries exist some throbbing of the arteries and increase of the temperature of the paralysed parts. These conditions are due to para-

lysis of the arteries as a result of injury to their vaso-motor nerves. At a later period, however, this increase of temperature subsides, and a diminution can be detected. In exceptional cases the vaso-motor paralysis is associated with coldness of the parts, and it is probable, that when this coldness exists, it is due to great depression of the heart's action.

Prognosis in cervical injuries.

Prognosis.—The nearer the injury is to the respiratory centre the greater the danger to life. Thus, in injuries to the cervical spine above the origin of the phrenic nerve or third cervical vertebra causing paralysis, death may be instantaneous; when below this position, and the respiratory process is maintained only through the diaphragm, life is rarely prolonged beyond the third day, and, as a rule, not beyond the second. Mr. Hilton has, however, recorded in his lectures 'On Rest' a case in which a man lived for fourteen years completely paralysed from the neck downwards, after a fracture of the cervical vertebræ. A gentleman, aged twenty-nine, whom I saw with Mr. Roberts, of Southgate, November 25th, 1870, with complete paralysis of the whole body below the fifth cervical vertebra, caused by a fall upon the neck, was still alive in 1877, breathing solely by the diaphragm.

In dorsal or lumbar injuries.

When the cord has been injured in the lower dorsal or lumbar region, life may be prolonged for many months, the immediate cause of death being generally some renal or vesical mischief, some bedsore or other complication the direct result of loss of nerve power in the paralysed parts. The longer these complications are delayed by careful nursing and attention, the longer can life be maintained.

In other cases, again, in which only partial or no paralysis at all is present as a direct consequence of the injury, inflammatory changes may ensue in the injured part, and, spreading upwards, cause death. The prognosis in such instances will be mainly determined by the seat of the injury, and, the extent of the mischief in the cord.

Rules as to prognosis.

The lower the seat of injury, the better the prospects of a cure; and the less the cord is involved in the mischief, the greater the chances of a recovery.

Thus fractures of the lumbar region are quite capable of a complete cure, and fractures of the lower dorsal vertebræ are not unfrequently recovered from. Injuries to the cervical part of the spine are generally fatal, within three days. Injuries to the dorsal, when not proving fatal within the third week, may be survived for months, and even years, the duration of life being greatly determined by the warding off of the secondary complications which so frequently arise.

Care in manipulation.

Treatment.—The diagnosis of a fracture or dislocation of the spine having been made, the most essential point to attend to is, to keep the part absolutely unmoved. The patient should be examined with the greatest care, and moved with every possible precaution, as any motion will necessarily add to the injury the cord has sustained, and increase the danger to the patient. Any manipulation of the injured part, beyond the gentlest, is to be condemned as being likely to prove hurtful. Extension of the spine may be employed when much deformity exists, or, when severe pain arises from nerve pressure, but extreme caution is required in following this practice; it is not to be employed in every instance, but only when local symptoms seem to suggest the probabilities of a successful issue. I have

Extension in exceptional cases, good.

seen several cases in which marked relief was afforded by this course, and the records of surgery contain many more. Practised with discretion, extension of the spine is doubtless a valuable means of treatment.

When the patient is placed on his back, the parts have a natural disposition to fall into place; this position, therefore, must be maintained. The bed should be firm, yet elastic; and a water bed is the best, when it can be obtained; otherwise, a spring mattress or one of horsehair should be employed. It should be well protected by water-proof cloth, &c., from all contact with urine or fæces.

Retention to be relieved.

The condition of the bladder should be attended to from the very first. Retention is certain to be present for a time, and, over-distension is most injurious. The utmost care ought to be employed in drawing off the water. A moderate-sized elastic or the French vulcanite catheter should be used, and the operation repeated twice a day, night and morning. If the urine becomes offensive, the bladder must be washed out; but no syringe should be used. A stream of water ought to be allowed to run in and out of the bladder through an elastic tube attached to the irrigator and fitted to the top of the catheter, no force being applied. (*Vide* Fig. 321.) The application of leeches to the spine, or cupping, is seldom called for. The condition of the bowels must be attended to, and enemata are to be preferred rather than purgatives. The greatest care is needed to keep the patient clean, particularly when incontinence exists.

Washing out of bladder.

Treatment.

There are no special medicines applicable to these cases. The general health of the patient should be maintained by tonics and simple nutritious food; and sedatives should be given to procure rest and relieve pain.

Avoid bed-sores.

The condition of the back must be daily watched to prevent bed-sores. This is best secured by removing pressure as far as possible, or in relieving it by means of soft cushions and pads, the water cushion being the best, and also by keeping the parts dry. The application of a soft felt plaster over the sacrum and hips is sometimes beneficial, so also is the frequent application to the parts of some spirit lotion. Should it be necessary to turn the patient on one or other side, the attendants ought to be taught to rotate the hips and shoulders at the same time. By great care and attention, life may be prolonged, and even recovery may occur.

Question of trephining.

The subject of trephining the spine requires brief consideration. Cline was the first to put it into practice, and, on his great authority, the operation has been repeated, but with no success. The great argument, however, against the operation is derived from the fact, that in few post-mortem examinations has the condition of parts indicated that the slightest good could have been derived from its performance. The danger of a fractured or dislocated spine lies in the injury to the cord, the result of a stretching or crushing of its substance. When the cord is much injured by the accident, the mischief has been done, and no removal of the displaced bone can undo it or neutralise its evil. If the cord is uninjured no operation is called for.

Example.

One successful instance of trephining is recorded by Dr. Gordon, of Dublin, and, in rare and exceptional cases, it is possible the operation may be justifiable. To perform it because it may by chance do good

is not advisable. The onus of proving that an operation is likely to be of use, always devolves upon the surgeon who performs it. There is, however, reason to believe, that a cord may at times be only squeezed or pressed upon by effused blood, and, under such circumstances, relief might be afforded by removing enough bone to take away the pressure, and thus give the cord a chance of recovering itself.

Removal of portions of bone.

In the case of the young man referred to at p. 273, such a probability seemed reasonable, and, three months after the accident I cut down upon the injured vertebra, and removed the spinous process and lamina of the fourth cervical, thereby exposing the cord. No harm followed the operation, although no immediate good was produced. The wound healed rapidly, and, in the course of a few weeks, some slight power returned in the muscles of the shoulders, the patient being able to raise the arms from the bed. He, however, made no further progress; and yet I look upon the case as an encouraging one.

Le Gros Clark's remarks.

"The end proposed in an operation of this kind," says Le Gros Clark, "is to remove displaced bone which is supposed to press upon or irritate the cord; but it is most likely to prove abortive, from the inaccessibility of the displaced bone. If the cord have been crushed, and the operation have been consequently useless, probably life may thereby be only curtailed, but if the cord be not crushed, it appears to me that the best chance of the patient's recovery is thereby extinguished. Indeed, my conviction is that the operation has been advocated on the erroneous hypothesis that the spinal cord can be compressed without serious disintegration of its texture."

Wounds of the spinal cord.

Wounds.

These are very rare in civil life. They may take place, however, as the result of a stab or gunshot wound. If the cord is injured, some symptoms of paralysis will appear, corresponding with the part that is involved; the extent of the paralysis and its seat fixing the position of the wound.

Sprain of the back.

Sprains and their varied effects.

The word "sprain" is very broad, and, when applied to the back is indeed vague. It may mean simply a stretching of the muscles or ligaments of the back, or a more complete laceration of the latter, and separation of the spinous processes of the vertebræ with exposure or injury of the cord. The number of articulations in the spine, numbering nearly eighty, renders such an accident as a sprain a common occurrence; any twist of the spine, or forcible flexion, may consequently injure some of these joints. Sprains may, moreover, be followed by acute or chronic joint disease of a serious and insidious nature. When the head is bent violently forward, the muscles and ligaments may be so torn as to give rise to effusion of blood, swelling, and severe local pain. When the body is flexed with violence not sufficient to give rise to fracture, there may be the same results and so also, when a man falls upon his buttocks. In each case there may be external evidence alone of injury, or, there may be evidence of some affection of the cord, such as is afforded by the presence of paralysis, proving that the cord has been stretched, if not permanently injured. If the symptoms rapidly or even gradually subside, no grave mischief probably may have taken place. When these are persistent or obstinate, a less

The source of organic disease.

favorable opinion should be formed. If the lumbar region is the part involved, it is not uncommon for hæmaturia to appear, and this may be slight and pass away, or be more persistent. It is not generally a very serious symptom, unless the kidney is ruptured; as a rule, it disappears gradually, and no evidence remains that organic renal disease is ever the consequence. "Of the many cases I have witnessed," says Le Gros Clark, "I have never had reason to suspect that nephritis or organic disease followed." ('Brit. Med. Journ.,' Oct. 3rd, 1868.) Mr. Shaw, in 'Holmes's Surgery,' gives a case where the bleeding lasted for four days, ceased for two, and then reappeared in all its severity. After the lapse of two more days it again ceased for twenty-four hours, reappearing for a third time severely, then ceasing, and a good recovery followed. When the kidneys are diseased, and when calculi also exist in them, this symptom is more likely to appear after injury.

Hæmaturia.

Hæmorrhage into spinal canal.

Hæmorrhage may take place into the spinal canal as the result of a sprain, or, laceration of the ligaments, the blood probably flowing from a laceration of some of the large veins that surround the cord, or, from a spinal artery. Mr. Hewett has related a case of sudden death from a fall on the head, recorded by Dr. Devillc in 1843 ('Mém. de la Soc. de Chirurg. de Paris,' t. iii), in which no other injury was found to the nervous centres than hæmorrhage into the canal in its whole length. Mr. Le Gros Clark has recorded a second, in which a man was struck violently on the back, though there were no immediate spinal symptoms. Paraplegia soon followed, however, which extended upwards destroying life by asphyxia, and, after death, the theca was found distended with fluid blood derived from a ruptured spinal artery. He gives also another case somewhat similar in symptoms, though not in result, where the patient recovered after two years.

Treatment.

TREATMENT.—In all these cases of sprain, slight or severe, rest is essential, the sufferer being allowed to assume the position in which the greatest ease can be obtained. The application of ice in a bag is also of great service where much swelling or pain exists. In other cases, a warm poppy fomentation gives relief, or a mixture of belladonna and opium rubbed down with glycerine and applied on lint. When spinal symptoms are present, the greatest caution is needed, and the case ought to be treated as one of concussion of the cord.

Preventive treatment is all important, to ward off secondary inflammatory changes both of the spine and cord.

Rest in the horizontal position for seven or eight weeks is essential in all severe cases, and, even in milder forms, exercise must be sanctioned with caution.

When hæmaturia occurs, it requires no special treatment unless severe. Gallic acid, in gr. v or gr. x doses two or three times a day, may then be given, but, as a rule, this is not necessary.

CURVATURE OF THE SPINE.

There are two forms of curvature of the spine, *lateral* and *angular*. The *lateral* is due to a relaxation of the ligaments and muscles of the spine, which, in a healthy subject maintain the bony column in its normal position. The *angular* is caused by organic disease of one or more of the bodies of the vertebræ, or of the intervertebral substances. It is generally known as "Pott's curvature."

Lateral curvature.

Lateral curvature.

This is by far the more common of the two, and is generally found in girls between ten and twenty years of age; sometimes in young children, and is frequently, not always, associated with some want of power. It is more common in the middle and higher classes of society, where sedentary occupations and luxurious enervating habits too often exist, than in young women who make full use of all their muscles and lead an active life.

Early symptoms.

It is encouraged by any one-sided posture of the body, whether this be the result of some faulty habit, or of occupation; of over-use of one limb, or of any disease or deformity of a lower extremity which occasions shortening of the limb.

Deformity.

In its early stage it is seldom discovered, and attention, is, as a rule, drawn to the disease by some "growing-out" of one shoulder, generally the right, some distortion of the chest, or some tilting upwards of a hip. These deformities are frequently first noticed by dancing or drill masters. When a curve has taken place in the upper dorsal region of the spine to the right side, a compensatory curve is certain to be found in the lumbar to the left. In investigating a case, it is important to bear this fact in mind, as the consecutive or compensatory curve, unless of long standing, will soon be remedied when the original one has been cured.

Compensatory curve.

In some subjects there exists an exaggeration of the natural curves of the back. When it is in the upper dorsal region and backwards, it is called *cyphosis*, when in the lumbar and forward, *lordosis*. This latter curve is very frequently found as an accompaniment of hip disease, and in *rickets*. It is always present in congenital displacement backwards of the head of the femur.

Rotation of spine usually present.

Associated with the lateral curvatures there necessarily must be some rotation of the spine. The amount of this is very variable, and depends upon the extent of the curvature; it is, doubtless, due to the forcible bending of the bones downward with the ribs, these latter helping to rotate the vertebræ upon their axes. The bones may be so twisted that their transverse processes project backward, carrying the ribs with them, the anterior surfaces of the bodies of the vertebræ looking towards the convexity of the curve, and the spinous processes laterally towards the concavity. The thorax is thus much distorted, the side corresponding to the curve being expanded, and the opposite one greatly contracted. This is well seen in the annexed drawings, Fig. 83 taken from a living patient, and Fig. 82 from a preparation.

Diagnosis.

The diagnosis is not very difficult when the deformity is well developed, the double curve giving the spine a sigmoid form, which is typical. In less severe cases this curve can readily be removed by extension of the body, either by lifting the patient from the ground by a hand in each axilla, or by, what is better, the vertical suspension of the patient by his hands from a bar or a pulley. In the more severe forms, such as that shown in the following drawing, the deformity is permanent, the ribs are thrown out in an extreme degree, pushing the scapula outwards and upwards, and the lumbar curve is in the opposite direction to the dorsal. The whole thorax, abdomen, and pelvis are altered in shape and position by the deformity.

Treatment.

Treatment.—In treating these cases it is necessary in the first

place to determine the cause of the deformity. Should there be any structural disease, such as a growth, or carious bone, these will require

Fig. 82.

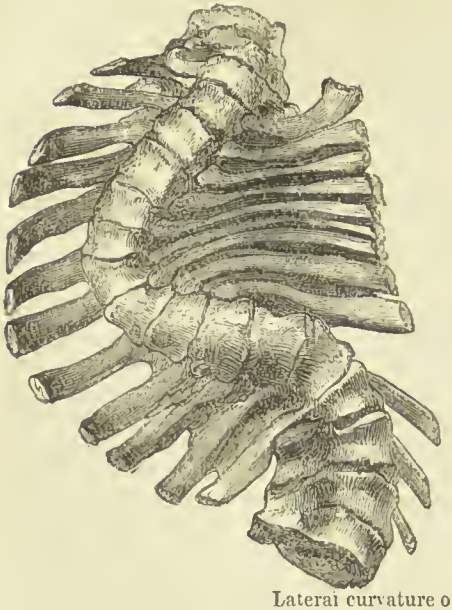


Fig 83.



Lateral curvature of the spine.
Anterior view. Posterior view.
Guy's Hosp. Mus., No. 1006[60]. Taken from Emma J—, æt. 14.

attention, and the alteration in the spine becomes thereby a secondary matter. But in the great majority of cases of lateral curvature, the spinal affection is the result of impaired health, and constitutional remedies are demanded. The treatment must be directed to an improvement of the general health, and tonics, such as iron, quinine, and cod-liver oil, should be administered. Good air and good food are essential, and in certain cases local treatment is of great value.

When due to debility.

The feeble muscles and weakened ligaments should have rest, though they are to be kept in health by moderate exercise, they are never, however, to be fatigued. If fatigue be experienced from walking one hour, such exercise must be curtailed to a shorter period. If backache be produced by exertion, less must be taken. Exercise is to be allowed, but not to the extent of producing fatigue. Sitting and standing ought not to be sanctioned. The patient should recline at stated intervals in any position that gives the greatest ease. When the deformity is definite and the dorsal curve is to the right side, as is nearly always the case, the patient should rest upon that side with a pillow beneath the right arm; the weight of the body in that position acting as an extending force upon the curved spine, and thereby tending to reduce the curve. By resorting to this practice two or three times a day for a definite period, depending upon the nature and severity of the affection, much good may be obtained and very severe curvatures remedied. Cold sponge or shower baths, if they can be borne, are always beneficial, so also is a moderately firm bed, a spring mattress being better than a feather bed. Gentle calisthenic exercises are valuable adjuncts to treatment when practised with discretion, and particularly the voluntary vertical ex-

tension of the patient's body by manual suspension from a bar or pulley; yet, it should be remembered, that a weak spine is being dealt with, and anything like violence may be very detrimental.

Should the curvature have been encouraged by any faulty habit, such as standing on one leg, or in one position, or the use of one arm, it is almost needless to say that the habit should be discontinued.

General objects of treatment.

The objects of treatment are, therefore—1. To improve the general condition of the body. 2. To give rest to the strained and weakened muscles and ligaments. 3. To strengthen the muscles that support the spine by exercise, which must be carefully regulated to prevent fatigue. 4. To restore the spine to its normal direction by posture, and by pressure applied in the horizontal position.

On mechanical support.

Mechanical contrivances have been much vaunted, and are often employed. I confess, however, to having little faith in their value as *curative agents*. They tend to cause atrophy of the muscles that support the back instead of strengthening them, and thus to make the deformity permanent.

Useful in exceptional cases.

In bad and exceptional cases they may, however, be employed when the treatment sketched out cannot be borne or is inapplicable, and of all supports that of Sayre's is the best. When the deformity is irremediable and support essential to allow the patient to move about, such an instrument is of great value.

It is probable that the deformity in its early stage chiefly arises from a compressed condition of the intervertebral substance, it being well known that this material is capable of being compressed one fourth of its thickness. Hence a person by maintaining the erect posture during the day, will be an inch shorter at night than in the morning. Any lateral curvature of the spine, however produced, unless remedied, will increase and be complicated with rotation. When unequal vertical compression is therefore kept up, the deformity produced by it becomes permanent, and the growing bones necessarily assume shapes and positions corresponding to the deformity, and tending to increase it.

Angular Curvature of the Spine.

Angular curvature.

This, which is generally known as Pott's curvature, is due to a destructive inflammatory change of the bodies of the vertebræ and intervertebral substances. It begins usually in the latter structure, although the bone itself may be its primary seat, and is at times associated with tubercular deposit in the tissue, though there is no evidence to prove that it is always due to the presence of tubercle. The curvature is directly due to the destruction of the bodies of the vertebræ and the intervening intervertebral substance, the upper vertebra falling down towards the lower, and joining with it. When the bodies of many of the vertebræ are involved, the deformity will be severe; a preparation in Guy's Museum (1006[50], Fig. 84) shows the bodies of twelve vertebræ implicated, but a cure resulted.

Pathology.

Spinal paralysis.

Paralysis may attend this affection, though it is rare to find the cord involved in the disease; the most destructive changes taking place in the bones; great deformity, even to an acute bending of the cord, may exist, without giving rise to nervous complication (Fig. 85). The paralysis too may be lasting, but more commonly is only temporary. Angular curvature may occur at any period of life, but is more liable to appear during the growth and development of the spine; and, consequently, is more frequently found in childhood. From a remarkable preparation in the

Guy's Hosp. Mus. (1004[92]) it would seem, that it may attack the fœtus in utero, the bodies of three or four of the dorsal vertebræ in this case

Fig. 84.



Angular curvature of the spine.

Fig. 85.



Angular curvature of the spine, the same as that illustrated in the former figure, taken from a patient æt. 35.

being clearly fused together from disease, thus giving rise to augular curvature.

Termination in anchylosis.

When a cure takes place, it is geuerally by anchylosis; occasionally, however, the parts are held together simply by fibrous tissue.

Situation of the disease.

The disease more commouly attacks the lower dorsal region of the spine than auy other, although the cervical and lumbar regions are not seldom implicated. In rare cases, it attacks two differeut regions of the spiue. It may run through its whole course even to a cure, without giving rise to auy external suppuration; more commouly, however, au abscess makes its appearauce.

Spinal abscess.

Spinal abscess.—Pus will sometimes find its way from the dorsal region beneath the fascia that covers in the psoas muscle under Poupart's ligament, and then appear as a swelling in the groin at its inuer half (*psoas abscess*). The swelliug may burrow downward, and involve the whole thigh iu one large abscess. Wheu the disease is in the lumbar regiou, pus may burrow betweeu the dense layers of fascia that bind in the quadratus lumborum muscle, and appear in the front of the abdomeu, above Poupart's ligameut, or in the loiu (*lumbar abscess*). Iu other cases, it will make its way under the fascia that covers in the iliacus muscle, and appear beneath Poupart's ligamcut, but at its outer half. In other instauces, again, the matter will find a passage downwards iuto the pelvis, aud either make its way through the sciatic notch into the gluteal regiou (*gluteal abscess*), or pass dowuwards behind the trochanter major to the thigh. In still rarer cases the pus appears by the side of the rectum.

Psoas abscess.

Lumbar abscess.

Glutcal abscess.

Pharyngeal abscess.

When the cervical region is the seat of the disease suppuration may appear in the pharynx as a *pharyngeal abscess*, or externally in the neck behind the sterno-cleido-mastoid muscle. The following case is a good example of this:

A boy, æt. 3, was brought to me at Guy's, in 1862, for some affection of his upper cervical vertebræ, consequent on a fall down stairs upon his head. An abscess formed two months after the accident behind the left sterno-cleido-mastoid muscle, from which place a piece of the lamina of a vertebra escaped six months afterwards. He kept his bed for upwards of a year, when he got up with a stiff neck. He was unable to nod or rotate the head, clearly showing that the joints between the occipital bone and the first two vertebræ had been diseased and become anchylosed. In 1867 this boy again came under my notice. His head was quite fixed; the cervical vertebræ seemed shorter than usual, but no irregularity existed. Examples.

The annexed drawings (Figs. 86, 86A, 86B), taken from Ellen T—, æt. 14, a patient of Mr. Poland's, illustrate a severe case of cervical disease with lateral deformity. In this patient, a good result was obtained by means of the apparatus depicted in Fig. 86B, the cure resulting in anchylosis.

FIG. 86.



FIG. 86A.



FIG. 86B.



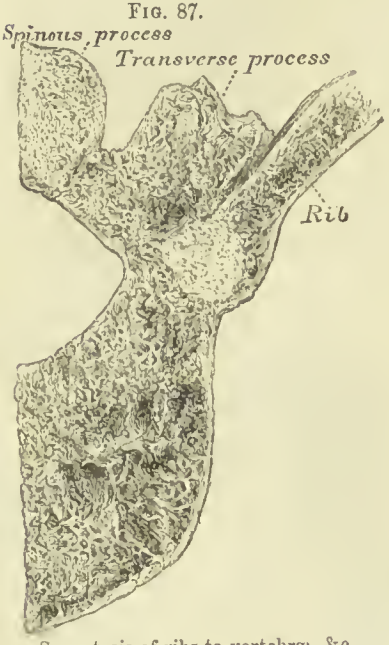
From any of these abscesses bone may exfoliate, and it may be coughed up from the pharynx, or discharged through the neck. I have seen a mass of bone, the size of a nut, come away from a lumbar abscess, and a piece of bone, clearly spinal, discharged from an abscess of the thigh, opening above the knee-joint. In a case brought under my notice by a valued dresser, Mr. Burgess, the anterior half of the atlas, with its articular facets, was expectorated, recovery ensuing; and, in Guy's Hosp. Museum, there is a preparation of the odontoid process similarly got rid of. In fact, from all these *spinal abscesses*, bone may be discharged, and, what is more, recovery follow. Exfoliation of bone.

Suppuration, however, does not always take place. A woman, æt. 30, came under my care in 1859 for a stiffness of her head and neck, that had been increasing for two years, and which she regarded as rheumatic. When I saw her the head was immovably fixed and slightly rotated to the right side. Rotation and nodding were impossible. There was much thickening about the cervical vertebræ, with pains darting upward to the vertex and downward to the shoulder. By rest in bed, fomentations, and tonics, all these disappeared and recovery ensued, but with a stiff neck. My colleague, Dr. Fagge, has also recorded in the 'Path. Soc. Trans.' for 1877 a remarkable case of synostosis of the arches of the vertebræ, of the ribs to the vertebræ, Anchylosis without suppuration.

and hip-joint, in which a bending of the dorsal vertebræ forward with immobility were the only symptoms of spinal disease that existed (Fig. 87). It occurred in a man, æt. 34, who died with inflammation and dilatation of the bronchial tubes from asphyxia, his breathing having been entirely diaphragmatic from a want of movement in the costal joints.

Diagnosis.

FIG. 87.



Synostosis of ribs to vertebræ, &c.

Difficult in early stage.

Diagnosis.—When any acute angular curvature of the spine exists there can be no difficulty in recognising the nature of the disease, or the process by which the curvature has been brought about. When a large abscess coexists with the deformity, there is good reason to suspect, that the one is the direct result of the other, more particularly when the suppuration can be traced up to the spinal deformity. The difficulty of diagnosis is felt in the early stage of the disease before any local change has taken place, and, it is here that great care is needed, because if any decided good is to be gained by treatment, it is at this early period. What, then, are the indications which denote the presence of spinal disease? *Local and persistent pain* is probably the earliest, and when this is accompanied by *local tenderness* on firm pressure the surgeon's suspicions should be excited. When to these symptoms the patient exhibits a *rigidity of the spine* in walking or moving, when, on being told to pick up anything from the ground, *he bends his knees in preference to bending his back*, the diagnosis becomes more certain. When pain is detected in the course of any of the nerves coming from the seat of the affection; when the patient complains of any sudden jar of the back by a slip down stairs or by any jump; when any constitutional disturbance is present, such as a quick pulse, occasional febrility, and a furred tongue; when all these symptoms, or many in combination exist, during that period of life when bones are growing, and bone disease is apt to appear, the surgeon should always suspect disease of some portion of the spine, and, until he can satisfy himself that none such exists, it is a wise plan to treat the case as if it were present. It is true that, by adopting this rule of practice, he will be occasionally misled, and at times treat a case of hysteria as one of spinal disease; but then what harm? He will probably do good to the hysterical patient by the treatment he would adopt for the spinal complaint, while he would certainly do much harm to the latter, by neglecting such measures as are essential for its successful treatment.

Mode of detection.

May simulate hysteria.

Treatment.

TREATMENT.—It is an interesting clinical fact that the best cases of recovery from the worst examples of spinal curvature and disease are to be found amongst that miserable class of patients who have never

had any chance of receiving proper treatment; who have never had rest or any care; in whom the disease has run its course untended and uncared for, and yet, in whom a cure has taken place with firm anchylosis, although with deformity. The majority of these cases are examples of disease of the dorsal vertebræ. How far this deformity might have been lessened or prevented by proper treatment, is an open question. Nevertheless it is beyond all doubt, that in the early stage of this disease, immobility of the spine, rigidly and persistently maintained, and the removal of downward pressure are absolutely essential points of practice to be observed. Not, however, rest upon the back, for in many instances this supine position tends rather to separate parts that ought to be kept in contact; but rest in any position, prone or supine, the patient feels to be most comfortable. Value of immobility.

The general health of the patient must be maintained, as much as possible, by simple nutritious food, stimulants enough to assist digestion, and no more, with tonics, such as iron, quinine, and cod-liver oil.

When pain exists, local fomentations are often a comfort; occasionally too the application of a few leeches relieves. Small flying blisters placed alternately on either side of the painful spot are sometimes of use, and a plaster of belladonna or opium rubbed down with glycerine over the part, is a valuable adjunct. When severe nerve pain is present, the hypodermic injection of morphia may be used. Sedatives must be given to induce sleep when it cannot otherwise be obtained. Setons, moxas, and mercury are not to be recommended. Setons condemned.

By the adoption of this line of treatment a cure may be obtained. It must, however, be followed out for months, and even years; the greatest care being taken that the patient is not released too soon, for a relapse is always a very serious affair.

Dr. Lewis A. Sayre's plaster-of-Paris jacket appears to me to be the best kind of apparatus, for it is simple, economical, easily applied, and efficient, securing absolute immobility of the spine, and at the same time giving comfort to the wearer. It can be readily applied by any medical practitioner with little expense, and does not debar the patient from the benefit of fresh air and change of scene. Sayre's jacket.

The body of the patient to whom it is to be applied is first to be covered with a thick closely-woven merino shirt, which is to be fastened above over the shoulders, and below between the thighs; in a female over a handkerchief. A pad of sufficient size, which Sayre calls a dinner pad, is then to be introduced beneath this shirt over the region of the stomach, of sufficient size to supply, when it is removed, a space which will permit of distension of the abdominal parietes. The patient is then to be supported by straps carefully adjusted to the axillæ, symphysis mentis, and occiput (Fig. 88), attached to the extremities of a cross bar which may be suspended from a hook fastened to a beam or high door by a compound pulley, the body being sufficiently suspended to allow of its weight serving as an extending force, but *always within the limit of pain.* The trunk is then to be carefully encased from below the crests of the ilia upwards to the axillæ by the rapid application of coarse muslin or crinoline bandages, 2½ inches wide, into which *dry freshly-ground* plaster-of-Paris has been rubbed, the bandages just before they are used being placed vertically in tepid water deep enough to cover them, and left a sufficient time to allow all bubbles to escape. The bandages should Its application.

be well squeezed before they are rolled round the body, and in their application care should be taken to see that they are applied flat, without making any traction, and well smoothed down. It is well also during this process to wet the jacket with water, and rub in more plaster.

FIG. 88A.

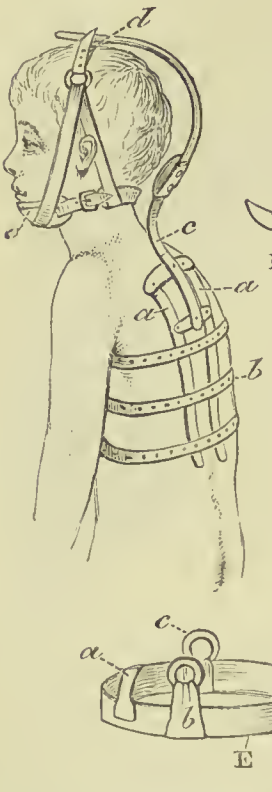


FIG. 88.

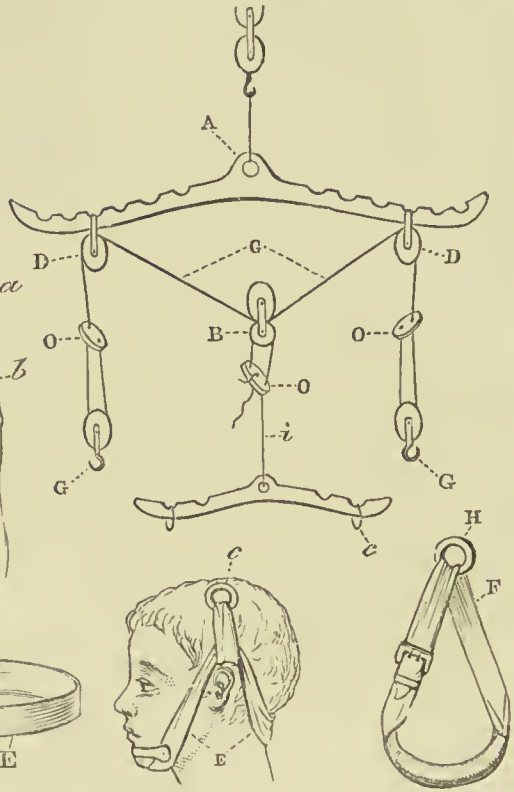


FIG. 88.—Description of Sayre's apparatus as improved by Golding Bird, by which the drag on the arms and head can be varied by altering the relative lengths of cords I and G. The smaller the angle at G the more the drag on the head, and *vice versa*.

A. Cross-bar suspended by running tackle to Sayre's tripod or to hook secured to cross-beam of a folding door. B. Pulley, acting upon central bar, to the end of which are suspended the iron rings *c*, attached to head-piece, E. D. Pulleys connected with arm suspender, F, by hook G, and H, ring, worked by running cord 36 inches long, which can be lengthened at will and fastened by cleats, O. E. Head-piece made of 2-inch worsted webbing sewn into a circle 27½ inches for adult, 23 inches for children, with (*a*) chin-piece made of wash leather, and (*b*) two circular sliders of same web, 6 inches round, attached to iron rings, C. The sliders, by being slid forwards or backwards, can be made to pull more or less against the chin or occiput. F. Arm pieces made of 2-inch cotton web one yard round, capable of being shortened by buckle. They are softly padded with horse-hair in the middle, and covered with wash leather; each carries an iron ring, H. On first suspending a patient the running cord, G, should be at its shortest, the centre cord, *i*, at its longest.

Fig. 88A. Sayre's jury-mast apparatus.—*a*. Two pieces of malleable iron bent to fit the curve of the back. *b*. Three or more roughened strips of tin attached to iron, long enough to encircle the body. *c*. Central shaft carried in a curve over the top of the head and capable of being elongated at will, springing from cross-pieces of *a*. *d*. Swivel cross-bar with hooks attached to end of *c*, from which straps depend to support head and chin collar, *e*. This apparatus is applied over the jacket with a plaster bandage.

The patient should be laid down in the recumbent position upon a mattress before the plaster is quite set, the dinner pad removed, and the casing slightly flattened in front of the anterior superior spinous processes of the ilium, to guard against pressure. The merino jacket may then be unfastened beneath the thighs and above the shoulders, and turned at both ends over the casing, the ends being fastened down by a few extra turns of the plaster bandage.

In the course of a fortnight, if all things go on well and no evidence of undue pressure in any part exists, the casing may be split up along the front, its edges bound, eyelets introduced, and a lace inserted, in order that it may at times be removed for personal cleanliness and comfort, and reapplied. The jacket should be worn so long as it is easy, and when worn out another should be substituted.

When extra support is required.

Where extra support is needed strips of tin three quarters of an inch wide may be bound round the thorax, or applied vertically beneath the bandage; and when the cervical or upper dorsal region is diseased a vertical splint, Sayre's jury-mast apparatus (Fig. 88A), to take off pressure of the head and prevent rotation, will be required. When this splint is used for lateral curvatures the patient should suspend himself by his arms.

Dinner pad.

The dinner pad should be made of cotton wool, folded in a handkerchief so as to form a wedge-shaped mass with thin edge downwards. In female patients, a pad should be placed over each breast and removed with the dinner pad just before the plaster sets. Smaller pads may be placed over the anterior iliac spines, and all prominent spinous processes protected from pressure by felt plaster. "When the disease is situated in the dorsal region the jacket should not be opened, for the reason that if the respiratory movements of the chest are permitted to go on without restraint, the heads of the ribs will necessarily move freely and the disease will be increased rather than diminished. But if the ribs be held still, and the diaphragm thus made to act more fully, the breathing, instead of being thoracic, is rendered diaphragmatic and abdominal, and all the short, grunting, catching respiration ceases."

Protection of projecting points of bone.

In *acute* or progressive disease suspension is dangerous, and vertical extension is to be applied with the greatest caution. Immobility of the spine is the essential object to secure.

Caution.

Treatment of spinal abscesses.

Spinal abscesses should not be opened hastily, inasmuch as they may become absorbed and wither away. When steadily progressing, however, they must be dealt with, and the best method is without doubt to make a free opening under a piece of lint saturated with oil carbolised or not. I have, however, in some cases, made a free opening into the abscess without any such precautions, and with an equally good results—making it so free tha tno pus could be retained, and, if air got in, it as freely got out again. Retained pus and air are sure to decompose, but if a free vent be made for both, harm rarely ensues. To allow abscesses to enlarge to any extent without interfering, is not good surgery, as the amount of constitutional disturbance that follows the opening of an abscess is closely proportioned to its size, and a large abscess cavity secretes more pus than a small one. It is true, that after the opening of a chronic abscess, a patient who may have been fairly well becomes feverish, and possibly exhausted by hectic; but it should be remembered, that by delay, the abscess will become

larger, and the constitutional disturbance as a consequence more severe, when the opening has taken place.

Disease of cervical vertebræ.

Disease of the upper cervical vertebræ.—Disease of the upper two cervical vertebræ and of the occipital articulation is often found, and may be accounted for by the greater mobility of the joints, and consequent liability of the ligaments to sprain and laceration. Disease may be situated in the bones entering into the formation of the joints, or, in the soft parts binding them together; and, with the disease, some displacement of one of the vertebræ is occasionally met with. When the disease is in the second vertebra, the odontoid process may separate and even exfoliate. Such a result took place in a case illustrated in

Exfoliation of odontoid process.

Guy's Museum, prep. 1018[15], in which a woman who had had a stiff neck for months coughed up the ulcerosed odontoid process; recovery took place with a stiff neck, and four years subsequently, the woman was following the occupation of a barmaid.

Giving way of the transverse ligament.

When the transverse ligament is diseased, the odontoid process may become displaced and the cord injured (Guy's Museum, prep. 1289[32]). When the displacement is great, sudden death may take place under these circumstances; and when partial, more or less paralysis may ensue, according to the amount of pressure the cord has sustained. Fixed pain about the cervical vertebræ with pain in the distribution of the occipital nerves and stiff neck, is always suspicious of cervical disease; and, when aggravated by rotation or downward pressure of the head, the case is serious. Under these circumstances, the aspect of the patient is very characteristic; the chin is tilted up, and all the muscles of the neck become rigid; the patient may even support the head with his hands.

Treatment.

TREATMENT must be conducted on recognised principles. The danger of sudden death by the displacement of the bones must be diminished by the application of a support to keep the head straight and prevent its falling forwards, and this may be accomplished by the application of a collar round the neck, passing under the chin with a support embracing the head, or by Sayre's jury-mast apparatus (Fig. 88A). Rest in the horizontal position is, however, of greater value, care being observed to keep a small firm pillow underneath the neck, to preserve the hollow, and in this way, as pointed out by Hilton in his classical work on rest, "to lift up the body of the second vertebra and remove the odontoid process from the lower part of the medulla oblongata, and thus prevent the fatal results of pressure upon it." At the same time the head should be kept at rest by means of sand-bags applied laterally. Remedies that have been mentioned in the treatment of angular curvature of the spine are here of use. In cases of severe spinal curvature, there is good reason to believe that the span of life is often shortened, on account of the interference with the respiratory and circulatory functions caused by the deformity. My colleague, Dr. Fagge, has written an interesting paper on this subject. ('Guy's Hosp. Rep.,' 1874.)

INJURIES AND DISEASES OF THE NERVES.

Contusions.

When a nerve is struck or contused, pain is produced, and it may be of a passing tingling character, or of a far more severe kind. Most people are rendered familiar with these facts, by an occasional blow upon the ulnar nerve, or what is called the "funny bone." When the

blow has been severe, the pain may be lasting, and the functions of the nerve so disturbed or interfered with as to give rise to loss of power or sensation in the parts supplied by the injured nerve. A man, æt. 29, went to sleep with his elbow resting on a table, and when he awoke there was complete paralysis both of motion and sensation of the parts supplied by the ulnar nerve. When I saw him two days afterwards, these symptoms were very marked; there was also tenderness over the nerve behind the inner condyle; to which spot a blister was applied. In a fortnight returning sensation appeared, with some slight power of motion; and in five weeks he was well. This was clearly a case of paralysis of a nerve from contusion. A man, æt. 46, received a blow upon his ulnar nerve against a chair. No pain appeared at the time, but three hours later, pain and numbness showed themselves, and at this time some thickening over the spot could be made out. In the course of three weeks these symptoms disappeared and recovery was complete. In this case it would apppear, as if some hæmorrhage had taken place into the nerve sheath, giving rise to the paralysis, which disappeared as the blood was absorbed. Examples.

Wounds of Nerves.

When a nerve is *wounded*, pain is produced, and this may be of a passing or more permanent character. In nervous, hysterical subjects the nerve pain is sometimes severe and persistent, and is then called neuralgia. It may be confined to a branch of the injured nerve, or it may involve the whole trunk. Wounded nerve.

When a nerve is *divided*, complete paralysis of the parts supplied by it follows. It may, however, reunite and recovery may thus take place. Paget, in his 'Lectures on Surgical Pathology,' 3rd ed., has related a case of complete division of the median nerve, in which the trunk had nearly recovered its conducting power a month after the wound. I have seen a similar case in which recovery ensued in four months. The following is another example in point. A woman, æt. 30, came to me with an incised wound behind the inner condyle of the humerus. The ulnar nerve had been completely divided, and there was perfect paralysis of motion and sensation of the parts supplied by it. The edges of the wound were adjusted and the arm placed in a sling. A month later, she returned with a burning pain in the little finger, which was really cold, but red, swollen, shining and blistered; and, when touched, some slight sensation was produced. Cotton wool and oiled lint were applied, and the arm was fixed upon a straight splint. The original wound had nearly healed. In two weeks the finger looked natural; sensation in it and all other parts supplied by the nerve had improved. In another month she returned with the old symptoms as bad as ever. They had reappeared upon the removal of the splint two weeks previously; but on its reapplication with the cotton wool, they again disappeared. The splint was then kept on for two months when sensation became natural, complete repair having taken place in four months. When seen six months later, she was still well. Divided nerve. Example.

The red, swollen, shining, and blistered condition of a finger deprived of nerve force is characteristic, and is generally associated with the sensation of a burning pain and loss of temperature, amounting sometimes to a depression of 9° or 10° Fahr. These symptoms are clearly due to mal-nutrition. When the nerve repair does not take place, these symptoms are very apt to return from time to time, on any change Characteristics.

of temperature or depression of the general power of the patient. When the ulnar nerve is completely paralysed, in which case atrophy of the muscles supplied by it ensues, the aspect of the hand is very characteristic, the wasting of the interosseous muscles, with the abductor indicis (also an interosseous), and all those of the little fingers, giving rise to a peculiar hollowing of the parts between the metacarpal bones which is typical. Nerves, when divided, do not, however, always reunite. When a piece has been removed, either by accident or by design, as in the operation for tic douloureux, the restoration of function is very rare, though it may occur.

Treatment. TREATMENT.—Bruised nerves are to be left alone, natural processes being, as a rule, amply sufficient to effect a cure. When recovery is slow and associated with pain in the injured part, the application of a small blister is beneficial. When a nerve is divided, it is well to put the divided ends as closely in contact as possible; to place the limb in such a position as will prevent any separation of the divided portion; to keep the paralysed parts warm with cotton wool and of an equable temperature, and the whole limb at rest, until complete repair has taken place. The application of a suture to a divided nerve is a legitimate proceeding; though not, however, uniformly successful. Mr. Favell, of Sheffield, has, recently published some evidence in favour of the practice ("Address on Surgery," 'British Medical Journal,' August 5th, 1876), and Dr. Weir Mitchell has shown that in 120 cases of nerve section, regeneration of nerve took place in most in about six months ('American Journal of Medical Science,' April, 1876). When much nerve pain exists belladonna or opium rubbed down with glycerine is a nice application, and the hypodermic injection of morphia is often of much value.

Neuralgia. **Neuralgia, tic douloureux.**

The subject of neuralgia belongs more properly to the physician than to the surgeon, yet the latter is often called upon to consider cases of this nature. The first point to determine is whether the pain is due to any Local cause. local cause, and, if so, to remove it. Thus, a decayed tooth too often is the cause of pain in the course of branches of the fifth nerve, although the tooth may have neither ached nor exhibited any external evidence of decay. The pressure of a small tumour on a nerve, some irregularity in the bone, or a cicatrix involving a nerve, are causes which sometimes require the surgeon's interference to effect a cure. The follow- Example. ing example illustrates these remarks:—A man, æt. 41, came under my care in 1866 for severe pain down the anterior and outer portion of his left leg and foot, with almost complete paralysis of the extensor muscles. The symptoms had been coming on gradually for years, and had followed a severe wound sustained twelve years previously, over the head of the fibula. There was a hard cicatrix over the head of the fibula, which clearly involved the external popliteal nerve. I made two deep vertical incisions on either side of the cicatrix, by this means taking tension off the nerve, and affording complete relief; six weeks later he was still well. Whenever neuralgic pain is associated with a cancerous tumour, or comes on after its removal, the surgeon should suspect the existence of some secondary cancerous deposit in the course of the sensory nerve.

The great majority of cases of neuralgia, however, have a constitutional origin, and their cause is to be found in some hereditary tendency, in depression, anxiety, or some obvious derangement of health,

such as is expressed by the term anæmia. Many, too, have a malarious origin, and depend on climatic influences such as residence in a damp or wet place. Cases of neuralgia are of frequent occurrence, and represent what would have been formerly ague, showing the influence of the miasmatic air. The disease known as "tic douloureux" is an affection of the fifth nerve and its branches, but any nerve in the body is liable to suffer. The pain is often very intense, and recurs in paroxysms at certain hours, or, on exposure to draught or cold.

Treatment. Treatment.—The treatment of these cases of neuralgia must be regulated entirely by their cause. When a local cause can be made out, its removal is the only remedy—for example, the removal of a tooth, of a tumour, or of a bulbous extremity of a nerve. When hysteria complicates the case, or any uterine disturbance, tonics are suggested, such as iron, zinc, or quinine, and of these, full doses may be given. When malaria appears to be the cause, bark or quinine is invaluable. In local neuralgia, more particularly in *sciatica*, the hypodermic injection of morphia in one-third or half-grain doses often acts as a charm. The fluid should be injected in the course of the nerve, and in all forms of neuralgia is of value. Chloroform, belladonna, and opium, locally applied, are also valuable. The general condition of the patient should always be attended to, and the treatment directed to its improvement. Good food, fresh air, and tonics, are always essentials. Purgatives are seldom necessary, and must be regulated so as not to depress. Stimulants, but not in excess, are of great use. In females, the condition of the uterine organs should always be carefully attended to.

Local. Local.

General. General.

In obstinate cases of neuralgia, the division of the nerve has been performed with occasional success. It is not, however, an operation in favour of which much can be said. When the cause of the neuralgia is peripheral, it may succeed for a time, but in these cases, spontaneous recovery is not unusual; and, when some central mischief is the source of the pain, the operation is not likely to be of service. Nevertheless, in desperate cases, the excision of a portion of the offending nerve is a justifiable operation; it has been of use, and may be so again. Sir J. Fayrer has related in the 'Medical Times' for 1868 a case of sciatica in a syphilitic man, æt. 30, in whom swelling was detected in the nerve sheath, and pain was at once relieved by puncturing the part with a knife.

Division of nerve. Division of nerve.

Neuroma.

Any tumour connected with a nerve is called a neuroma. These neuromata may be of a fibrous or of a fibro-cellular kind, and there is reason to believe that they have an inflammatory origin. They may be very small, or of large dimensions, and when large, they may contain cysts. Sometimes they are developed *within* the nerve sheath; at others they are situated *upon* it. In a third class the fibrillæ of the nerve trunk appear to be separated by the new tissue, or to become incorporated with the growth. They are at times single, but more frequently multiple; and occasionally involve nearly every cerebro-spinal nerve in the body. Wilks has recorded such a case in the 'Path. Soc. Trans.,' vol. x, in which, after death, neuromata were found all over the body, appearing as nodules on some nerves, and as distinct tumours on others; the nerves appeared of irregular size and were indurated, the fibrous

Neuroma. Pathology. Neuroma. Pathology.

tissue being infiltrated among the nerve-fibres. The pneumo-gastric nerve had a tumour the size of an egg upon it. Dr. Smith, of Dublin, in his unrivalled monograph on the subject, has recorded an instance in which many hundreds of such tumours existed; other similar cases might be quoted.

Symptoms. These tumours are not painful, as a rule; indeed, in the most marked examples of this disease, in which the tumours are multiple, they are often not recognisable till after death. Pain, however, is sometimes present, aggravated on pressure, and apparently depending much upon the mode in which the nerve is involved. This affection is not to be confounded with the *painful subcutaneous tumour*.

When the ends of a divided nerve become bulbous from fibrinous effusion, what is called a *traumatic neuroma* is formed. When this becomes involved in the cicatrix of a stump, it is an exceedingly painful affection, and is thought by some surgeons to be more common after flap amputations than others. It must be remembered, however, that all nerve trunks become more or less bulbous after amputation.

Treatment. TREATMENT.—There is no reason why neuromata should be removed or touched, unless they are large or painful. When from these causes they require treatment, the operation should be performed, care being observed to dissect the tumour from the nerve, when it is possible, which, however, can rarely be done. Many cases are on record in which large neuromata have been excised with the nerve trunk and a good recovery has followed, even with a restoration of the functions of the divided nerve. Traumatic neuromata should always be excised when causing much pain, but, when associated with symptoms of spinal irritation, which may possibly be due to a neuritis travelling up the affected nerve trunk, the forcible stretching of the nerve has been recommended by Billroth and Nussbaum, and practised by others; but the cases known to me in which it has been tried do not justify me in recommending the practice. It consists in the free exposure of the nerve trunk by incision and the application of forcible traction to it both proximally and distally. The traction has been great, as one author, in describing the operation as applied to the sciatic nerve, says that "the limb of the patient should be lifted from the table by the sciatic nerve."

Nerve stretching.

Painful subcutaneous tumours.

Painful subcutaneous tumours.

These tumours are clinically to be separated from the neuromata which have just been considered, although they have often doubtless been confused with them. They are not, however, nerve tumours. They were first described by Wood, in the 'Edinburgh Medical Journal' for 1812. They are usually single and situated in the subcutaneous tissue, and are rarely larger than a small bean. They are encysted, and give to the finger a hard elastic touch. To the eye they appear bright yellowish or a pearly white, and are made up of fibro-cellular or fibrous tissue. *Intense painfulness* is their clinical peculiarity, although they have no such nerve connection as will explain their excessive sensibility. The pain, says Sir J. Paget, is of the nature of that morbid state of nerve force which we call neuralgia.

Structure.

The painful character of these tumours is very peculiar. It is not constant, nor does it appear to depend upon any injury, and sometimes comes on without any assignable cause or after only the slightest touch, the pain beginning in the tumour, gradually increasing in in-

tensity and extent till it becomes almost unendurable, darting from the tumour up and down the limb or over the body. The muscles of the limb may likewise be spasmodically affected. The paroxysm may last only a few minutes, or may continue for hours, and subsides as it appears, gradually, leaving the parts tender that were the seat of pain. These painful tumours are most frequent in the female, the neuromata more frequent in the male.

TREATMENT.—The only treatment is the excision of the growth, which is generally effectual. These tumours rarely recur, although Sir J. Paget has recorded one or two examples of recurrence. Excision.

CHAPTER VIII.

DISEASES AND INJURIES OF THE EYE, &c.

By CHARLES HIGGENS.

EXAMINATION OF THE EYEBALL AND ITS APPENDAGES.

THE examination of the eyeball will be considered under four heads:—

1st. By the unaided eye.
2nd. By means of lateral illumination.
3rd. By the ophthalmoscope.
 (*a*) Direct examination.
 (*b*) Indirect examination.
4th. By manipulation.

The *refraction* of the eyeball, the field of vision, &c., will also receive a short notice.

I. Examination by the unaided Eye.

Examination by unaided eye.

In order to examine the outer surface of the eyelids, ocular conjunctiva, cornea, anterior portion of sclerotic, aqueous chamber, and lachrymal apparatus, it is necessary to place the patient in a good light (as before a window), and direct him at first to close the eyes, then open them widely, and look by turns in different directions.

How to evert upper lid.

To examine the palpebral conjunctiva it is necessary to evert the upper lid, and to draw the lower one downwards. Eversion of the upper lid can be accomplished thus:—The surgeon, standing in front of the patient, should direct him to look downwards and close the eyes; he should then place the forefinger of one hand upon the lid at the attached or upper border of the tarsal cartilage, and make gentle pressure downwards and backwards, so as to cause the free edge of the lid to stand away from the eyeball; then place his thumb beneath the margin of the lid, and make a slight upward movement, at the same time continuing the pressure with the finger; by this means the lid will be made to turn upon itself and become everted; the lid may also be everted by pressing a probe horizontally upon its outer surface, and drawing it upwards by means of the lashes, at the same time making pressure downwards with the probe.

To examine the conjunctiva covering the lower lid, all that is necessary is to place the finger upon the margin of the lid and draw it strongly downwards, when its conjunctival surface will become exposed.

Normal Appearances.

Normal appearance of eyelids.

The outer surface of the eyelids is covered by soft, delicate skin, which is thrown into folds on every contraction of the orbicularis; their free margins are of some thickness. From the outer edge of this free margin project the lashes in two or three rows, those of the upper lid being thicker and longer than those of the lower. The lashes extend along the whole outer edge of each lid, but are much fewer and more delicate in that portion extending from the tear punctum to the inner canthus.

The inner edge of each margin is occupied by the orifices of the Meibomian glands, which are seen as a close set of yellowish points.

Of conjunctiva.

The ocular conjunctiva is smooth, moist, shining, and transparent, allowing the white sclerotic to show plainly through it; a few vessels

Ocular.

are generally seen running from the outer and inner canthi towards the cornea, but these are perfectly consistent with a healthy condition of the membrane. The caruncle and semilunar fold occupy the space immediately external to the inner canthus, the former appearing as a small reddish-grey projection, the latter as a well-defined pinkish

Palpebral.

fold. *The palpebral conjunctiva* is also smooth, moist, shining, and transparent, and appears to have somewhat of a yellowish colour from the tarsal cartilage, to which it is closely and evenly united, showing through it. That portion of conjunctiva reflected from the lids to the

Fornix.

globe (*Fornix*) appears somewhat thickened and wrinkled, and is slightly more vascular than the ocular and palpebral portions.

Parts requiring special notice.

Certain parts of the conjunctiva require to be specially examined. The portions next the thickened margin of the lid, the fornix, and about the caruncle, are the most likely situations for the lodgment of a foreign body. That portion covering the attached border of the tarsal cartilage also should be noticed, as it is here that granular ophthalmia manifests itself most plainly.

Cornea.

The cornea is smooth, shining, and perfectly transparent throughout, except in the case of old people, in whom a bluish-white rim (arcus senilis) is often seen occupying more or less of the structure, somewhat within its margin; no blood-vessels are seen on its surface or in its substance.

Sclerotic.

The anterior portion of the sclerotic is pearly white, or of a pale bluish tint, and shining. It is plainly visible through the transparent conjunctiva covering it; some fine vascular twigs may occasionally be seen traversing it in front of its equatorial region. The aqueous chamber is filled by the aqueous humour, which is transparent, colourless, and of such quantity as to preserve the proper curvature of the cornea without causing tension, or allowing of laxity, and to keep it separated from the iris by a considerable interval.

Iris.

The iris varies in colour in different individuals; it is bright and smooth, presenting in health no appearance of blood-vessels. Its plane is exactly vertical; the pupil, situated somewhat to the inner side of the centre of the iris, is perfectly circular, and dilates and contracts quickly with variations of light.

Lachrymal apparatus.

The examination of the *lachrymal apparatus* gives chiefly negative results; the position of the tear puncta closely in contact with the ocular conjunctiva must be noticed; pressure with the finger over the lachrymal sac causes no escape of fluid through the puncta, neither

ean the lachrymal gland be felt or seen in a normal condition of the parts.

II. Examination by Lateral Illumination.

Examination by lateral illumination.

By this method all the parts mentioned above are seen more clearly, minute foreign bodies, slight opacities of the cornea, &c., which might be overlooked in examining with the unaided eye, are discovered, and in addition the whole of the lens and the anterior portion of the vitreous can most satisfactorily be looked into.

The method of examination should be as follows :—The patient should be seated in a dark room (the pupil having been previously dilated with atropine), and a lamp placed at about two feet distance on the left, and rather in front of his face. The surgeon should stand nearly in front, or rather to the patient's right side, and facing him; he should then take in his right hand a biconvex lens of about two and a half inches' focal length,[1] and with it concentrate the light on the surface of the cornea; with a little manœuvring he will find that he can throw the light through the pupil to a considerable depth into the eye. The patient should be told to look in various directions, so that all parts of the anterior portion of the eye may be examined.

Results obtained.

The results obtained by lateral illumination are chiefly negative. The lens in health is perfectly transparent, and in youth is nearly colourless, but some bluish lines showing its division into different segments can be recognised by careful examination. As age advances, these lines become more marked, and the whole lens appears of a bluish-grey colour, though its transparency is still unaffected.

Behind the lens all appears dark, but any tumour, hæmorrhage, &c., occupying the anterior part of the vitreous would be discovered.

It should be noticed in the examination by lateral illumination that opacities of the cornea, &c., always appear with greatest distinctness on the side which is farthest from the light. A second lens may also be used to magnify the parts illuminated by means of the first.

III. Examination by the Ophthalmoscope.

Ophthalmoscope.

Description of the instrument.—The ophthalmoscope, as used at the present day, consists essentially of a mirror of silvered glass or polished metal, having a central opening, with certain accessory portions in the shape of convex lenses of different foci, used as objective lenses; clips and other contrivances for holding ocular lenses behind the sight hole of the ophthalmoscope, together with the ocular lenses themselves. The ophthalmoscope since its introduction has undergone innumerable modifications, both in principle and detail; the number of different instruments now in use being nearly, or quite, as great as that of ophthalmic surgeons.

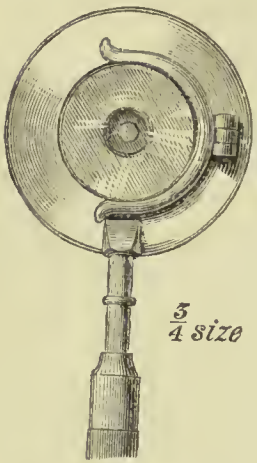
Liebreich's.

The most useful form of ophthalmoscope is that of Liebreich; the latest modification (Fig. 89) of this instrument consists of a silvered glass concave mirror of about eight inches' focal length, having a central opening in the silvering of a line and a half diameter. The mirror is fixed in a metal back, having a central perforation about double the diameter of the opening in the silvering. Upon the metal back is fixed a clip for the purpose of holding an ocular lens; the back is screwed to a handle about two and a quarter inches long. The

[1] A lens of two and a half inches' focal length is about equal to one of sixteen dioptrics in the metrical system (see p. 301).

accessory portions consist of two object lenses of two and a half and three inches' focal length respectively,[1] and five ocular lenses—two convex, of six and twelve inches positive foci;[2] three concave, of eight, twelve, and twenty-four inches negative foci;[3] all are made to fit into the above-mentioned clip. A very convenient case contains the whole.

Fig. 89.



Liebreich's ophthalmoscope.

Method of using the ophthalmoscope.—There are two methods of using this instrument. The first, which requires much practice, is called the direct method of examination, or examination of the *erect image*, with the ophthalmoscope alone, without the aid of a biconvex object lens.

The second, which is much the easier of the two, is called the indirect method, or examination of *the inverted image;* in it both the ophthalmoscope and a biconvex lens are used.

Examination of erect image.

Direct ophthalmoscopic examination.—In this method a virtual erect image situated behind the eye is seen. The examination is conducted in the following manner:

The patient being seated in a dark room, a gas or other lamp (gas being preferable) should be placed at the side corresponding to the examined eye, on a level with it, but so situated as to leave the cornea in shade; he should then be directed to look forwards and a little upwards, at some distant object, and to keep the eyes as steady as possible.

Position of lamp.

Supposing the right eye to be examined, the lamp should be placed at the patient's right side; the observer, standing in front at a distance of eighteen inches or two feet, should take the ophthalmoscope in his right hand, look through the sight hole with the right eye, and reflect the light from the lamp through the pupil of the patient's right eye. If the examination be conducted properly, the pupil will appear of a bright red colour. The observer should then look for the optic disc, which is situated rather to the inner side of the axis of the eyeball; he will know that the disc is in view from the alteration in colour of the pupil, which will turn from red to white, or pinkish white. Having obtained the peculiar reflection of the optic disc, the observer (taking care to relax his own accommodation) should approach the eye until an interval of only two inches separates his cornea from that of the examined eye. Some difficulty will be experienced in keeping the eye illuminated, increasing as the distance between the observed and the observer becomes less; this, however, will be overcome by practice. When the observed eye has been approached to within a distance of two to three inches (supposing both the examining and examined eye to be emmetropic), a distinct erect and greatly magnified image of the parts occupying the fundus of the latter should be obtained; most observers will, however, find the image sharpened in outline and detail by using a weak *concave* lens behind the sight hole of the ophthalmoscope. Should either the observer or patient be myopic, it will be

Use of concave lens.

[1] Sixteen and thirteen dioptrics, metrical system.
[2] About seven and three dioptrics, convex.
[3] About five, three, and one decimal five, dioptrics concave.

found necessary, in order to examine the erect image, to place behind the sight hole of the ophthalmoscope a concave lens, which rather more than neutralises the existing ametropia.

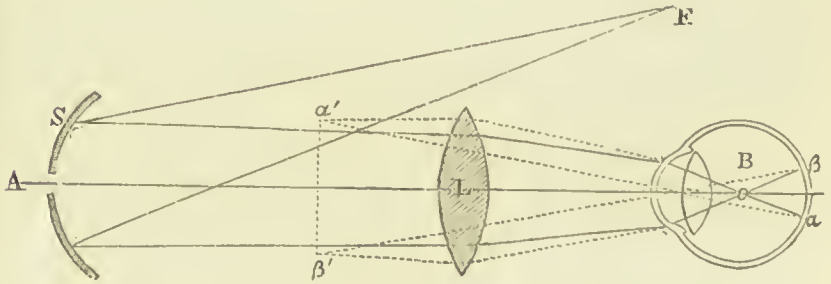
The examination of the erect image, although requiring considerably more practice than that of the inverted, should never be neglected, as it gives much more satisfactory evidence of minute changes in the fundus oculi, all the parts being seen highly magnified (about 14½ times). It gives, however, a less extensive field of vision, on account of the size of the objects, which only allows small portions of them to be seen through the pupil at one time. Size of image.

The optic disc, retinal vessels, and other parts occupying the fundus, should be examined by looking in different directions through the pupil; the observed eye being kept steadily fixed during the examination upon some distant and suitably situated object.

The right eye having been examined, the lamp should be placed on the patient's left side, and the manœuvre repeated; the observer using the left hand and left eye, instead of the right hand and right eye. The condition of refraction of the eye can be diagnosed by the direct method of examination. (*See* p. 302.)

Indirect ophthalmoscopic examination.—In this method of examination an inverted aerial image of the fundus oculi is formed by the interposition of a biconvex lens between the observer and observed eye. (*See* Fig. 90.) Inverted image.

Fig. 90.



From Carter's translation of 'Zander on the Ophthalmoscope.' A, Observer's, B, observed eye. F, The light. S, The mirror. L, The biconvex lens. α β, Some portion of the retina, or the disc. α′ β′, Its inverted aerial image formed between the mirror and biconvex lens

The position of the patient and observer should be the same as for the direct examination; the same lamp also can be used, but should be placed rather further back and kept on the patient's left side during the examination of either eye. The ophthalmoscope should be held in the same manner and the light reflected through the pupil as detailed above; but the red reflection having been obtained, the observer must not approach the eye, but remain at a distance of about eighteen inches. Method of examination.

The patient should be directed to look at some distant object so situated that the axis of the observed eye is turned somewhat inwards; this brings the optic disc (which lies somewhat to the inner side of the optic axis) opposite the ophthalmoscope, and its peculiar bright reflection will be at once observed.

The biconvex lens should then be held in front of the observed eye at a distance about equal to its own focal length from the cornea, and steadied by the observer resting his ring and little fingers on the

patient's brow. By this means an inverted image of the optic disc and vessels of the retina is immediately seen, which, although apparently within the eye, is in reality formed in the air between the observer and the biconvex lens, and (in emmetropia) at a distance from the latter corresponding to its focal length.

Position of image.

If the image of the disc appear indistinct, the observer may be sure that his own eye is not accommodated for the distance at which the image is situated, which is, in reality, shorter by some inches than it appears to be. Should this be the case, the observer must increase the tension of his accommodation, or withdraw somewhat further from the observed eye.

Use of convex ocular lens.

A better method, however, than either of the foregoing, is to employ habitually, behind the sight hole of the ophthalmoscope, a convex ocular lens of about ten or twelve inches[1] focal length. If this be done, a clear and well-defined image will always be obtained without tension of accommodation, provided precautions be taken that the distance between the observer's eye and the image be *not greater than the focal length of the convex ocular lens.*

The disc and parts immediately surrounding having been examined, the patient should be directed to look straight forward, so as to bring the region of the yellow spot opposite the ophthalmoscope; this having been carefully examined, the eye should be turned upwards, downwards, to the right and left, so that all parts of the fundus may be examined in turn.

In the indirect method of examination the observer should use his right eye, and hold the ophthalmoscope in his right hand and the biconvex lens in his left in examination of the right eye, and *vice versâ* in examination of the left.

Difficulties of Ophthalmoscopic Examination.

Inconvenience from reflections of mirror.

Considerable practice is required in order to become proficient in the use of the ophthalmoscope; the beginner will be frequently much disheartened at his want of success. Some of the difficulties are only to be overcome by practice, others are easily remedied. Reflections of the mirror from the two surfaces of the object lens often prove very

How obviated.

troublesome; the inconvenience arising from this source is obviated by holding the lens somewhat obliquely, when the two images will recede from each other and leave a clear space between them. Reflection from the surface of the cornea may be troublesome, but can usually be overcome by a little manœuvring. Contraction of the pupil is also an insurmountable obstacle to the beginner, but can be removed

Use of atropine.

by dilatation with atropine; for this purpose a solution of one grain to one ounce of water should be dropped into the eye about half an hour before the examination is made; or the patient may be ordered to use a solution of one eighth grain to one ounce two or three times on the day preceding it. When experience has been gained, however, atropine can be dispensed with, except in some few cases, or in those where it is necessary to make a very careful examination by lateral illumination.

If the patient be directed to look at a distant object the accommodation is relaxed, and sufficient increase in the pupillary area will generally take place.

[1] Four or three dioptrics.

Every ophthalmoscopic examination should be conducted on a certain definite system. Systematic examination.

The first step should be to examine the condition of the refractive media by lateral illumination.

Next, the condition of refraction of the eye and the state of the vitreous chamber should be ascertained by the direct method of examination.

Thirdly, a general survey of the fundus oculi should be made by the indirect method.

And fourthly, any abnormalities having been discovered by the indirect examination should be fully and carefully studied in detail by the direct method.

If this systematic plan of examination be carefully carried out few mistakes will be made, and no abnormality of importance is likely to be overlooked.

Normal appearance of parts seen by the Ophthalmoscope.

The refractive media (cornea, aqueous humour, lens, and vitreous), as stated under Lateral Illumination, are perfectly transparent. Normal appearances.

The retina is either quite transparent and colourless, or in dark eyes may appear as a faintly grey cloud, covering the choroid; it position is marked by that of its blood-vessels. The bright red reflection previously mentioned is due to the blood in the choroid; the depth in colour of the reflection varies with the amount of pigmentation of this vascular tunic—in blue or grey eyes it is light red, in dark ones of a much deeper tint, and in the negro appears to be dark blue. The parts of the fundus oculi requiring special attention are the optic disc and parts immediately surrounding it, and the region of the yellow spot. Retina. Cause of red reflection.

The disc appears at first sight to be of an uniform pale pink colour, but on closer examination different portions are found to present different shades. Optic disc.

Its centre is pale, or even white; next to this succeeds a zone of pink, this being again bounded by an apparently double border of lighter colour. The pale appearance of the central portion of the disc is caused by connective tissue surrounding the blood-vessels in this situation. The succeeding pink zone consists entirely of nerve-fibres and delicate capillaries. The outer pale double border is formed by the margins of the sclerotic and choroidal rings, which do not accurately cover each other, the choroidal ring being somewhat greater in diameter than the sclerotic opening, the margin of which, being left uncovered by pigment, shines through the transparent nerve-fibres.

Both the white central portion and the outer ring are in some cases so distinctly marked that the appearance produced might be taken by an inexperienced observer as evidence of disease, but both conditions are perfectly consistent with health. From the pale central portion of the disc proceed the retinal blood-vessels; these appear upon its surface usually at the same point, but may emerge separately or in groups of two or three. Peculiarities of optic disc.

As a rule about eight vessels are seen, upon or close to the disc, four of these being arteries, with a corresponding number of veins; two of each pass upwards and a like number downwards, to be distributed over the retina. The lateral branches are comparatively insignificant, Retinal vessels.

and are given off from the principal trunks, either upon the nerve surface or in the retina near its margin.

Distinction between arteries and veins.

The veins are distinguished from the arteries by being of greater calibre, the proportion being about three to two. There is also a difference in colour between the two, the veins being the darker; the arteries are marked by a double contour, and their central portion is much lighter than their borders.

Occasionally a dark spot is noticed in one of the vessels at its origin or termination in the disc. This might be taken for a clot, but the appearance is caused by a peculiar arrangement of the vessel, which at this point is seen, as it were, on end and foreshortened.

Spontaneous pulsation.

Spontaneous pulsation of some of the retinal *veins* may also be observed; the occurrence of *venous* pulsation is, however, perfectly consistent with health, and has no pathological import.

In any eye, pulsation, both arterial and venous, can be produced by pressure upon the globe, but should it occur spontaneously in the *arteries* has the gravest significance. (*See* Glaucoma.)

Anomalies of Optic Disc, &c., consistent with Health.

Certain phenomena are not unfrequently observed with the ophthalmoscope, which, although contrary to the condition usually met with, are perfectly consistent with a normal state of the parts.

The appearances caused by the connective tissue surrounding the central vessels, the occurrence of pulsation, unusual distribution, and existence of dark spots in the latter, together with the unusual distinctness of the sclerotic ring, have been already mentioned.

Other anomalies are—

Dark crescent.

1. *A dark crescentic* figure bordering some portion of the margin of the disc. This appearance is caused by a peculiar arrangement of the choroidal pigment; it is congenital.

Variations of colour.

2. *Variations in depth of colour of the disc* are frequently met with. Due regard must be had to the colour of the surrounding fundus in forming an opinion as to whether the tint in any particular case is so much deepened or lessened as to constitute a diseased condition.

In light eyes the disc appears much redder than in dark, the apparent difference being due more to contrast with the surrounding parts than to actual change in colour.

Slight deviations are only to be determined by careful examination and long experience.

Excavation of disc.

3. *Excavation of the optic disc.*—Not unfrequently a sloping or even abrupt depression is met with occupying the centre of the disc, but usually extending somewhat further towards the yellow spot than in other directions. The whole nerve surface, however, is never included in the cup; the vessels do not bend under its edge, their calibre is not altered, neither is spontaneous arterial pulsation observed, as may be the case in the excavation of glaucoma. (*See* Glaucoma.)

Hyaloid artery.

4. *Persistence of the hyaloid artery.*—Occasionally a small whitish cord may be seen extending from the centre of the disc to the back of the lens; it is the remains of a vessel which, during fœtal life, nourished the latter structure.

Senile changes.

5. *Senile changes.*—As age advances, the refractive media become less transparent, the retina grows somewhat hazy, and the disc appears whiter than natural.

6. *An appearance of white wisp-like patches*, extending from some part of the margin of the disc over the surrounding fundus. These patches have irregular jagged borders, and are often of considerable size; the retinal vessels pass through and are obscured by them. Occasionally white threads may be continued for a considerable distance along the sides of the vessels. Opacity of nerve fibres.

The patches are caused by the opaque nerve-sheaths which should end at the lamina cribrosa, being accidentally continued beyond this point into the transparent retina; they are congenital, and do not interfere with vision.

7. The choroidal vessels are at times (especially in light eyes) very plainly visible, appearing as an irregular network of pale pink bands. Choroidal vessels.

The region of the yellow spot presents in health no very marked ophthalmoscopic signs, but requires special notice, as it is frequently the seat of pathological lesions. In the normal condition it is recognised by the absence of blood-vessels, which appear to avoid this part of the retina, and pass above and below it; by some deepening in colour, and occasionally an indistinct, dark, transversely oval figure can be detected. Yellow spot.

IV. Examination by Manipulation.

The fourth method of examination, *by manipulation*, consists simply in ascertaining the tension of the globe by digital pressure. The examination should be conducted as follows:

The patient being directed to look downwards and close the eye gently, but not to screw up the lids, the surgeon should make gentle alternate pressure with the forefinger of each hand placed upon the closed upper lid; the pressure should be made in a direction backwards and somewhat downwards, so as to compress the globe against the floor of the orbit. Tension of globe.

In health the eyeball is firm, tense, and semi-fluctuating; in disease the tension may deviate in the direction of increase or decrease. The degree of tension may be expressed as follows:

If normal, as Tu; if above par, as T + 1, T + 2, T + 3, according to the amount of increase; if below par, as T − 1, T − 2, T − 3. If a doubt exist, as T + ? or T − ?, according as the doubt is on the side of increase or decrease.

REFRACTION, ACCOMMODATION, ACUTENESS, AND FIELD OF VISION.

Definition.—By refraction of the eye we understand the power which the refractive media (cornea, humours, and lens) possess by virtue of their curvatures and densities of bringing together *parallel* rays of light, and forming them into an image at a certain spot (known as the principal focus of the refractive or dioptric system), *without the employment of any adjusting power.* Refraction.

The refraction is said to be *normal* or *abnormal* according to the position of the retina with regard to the focus of the dioptric system. The former condition is known as *emmetropia*, the latter as *ametropia*, the terms normal and abnormal being seldom applied.

Emmetropia.—The emmetropic eye (Fig. 91 *a*) is of such a shape that the retina is situated at the focus of the *dioptric system*, and in Emmetropia.

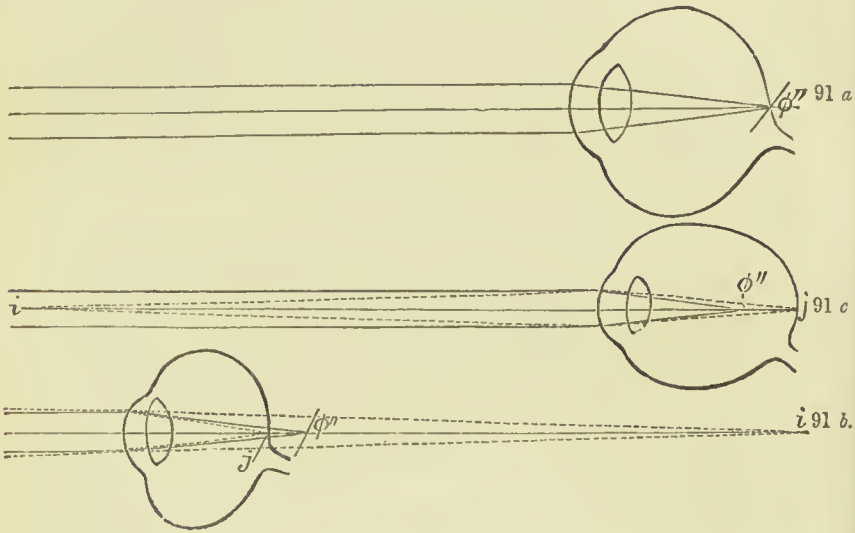
such a position that a distinct and inverted image of any object (*the rays of light proceeding from which are parallel*) is formed upon the layer of rods and cones.

Ametropia.

Ametropia.—The ametropic eye differs from the emmetropic in two opposite directions; the deviations are known as *anomalies of refraction*. In the first and (in this country)[1] most commonly met with anomaly the retina lies *within* the focus of the dioptric system; that is to say, the axis of the eyeball is too short from before backwards; and images of objects, the rays of light proceeding from which are parallel, are formed behind the retina instead of in its substance. This anomaly is known as *hypermetropia*, or far sight (*see* Fig. 91 *b*).

Hypermetropia.

Fig. 91.[2]



From Donders, 'Accommodation and Refraction of the Eye.'
a. Emmetropia. *b*. Hypermetropia. *c*. Myopia.

To the second anomaly an opposite state of things pertains; the axis of the eyeball from before backwards is too long, consequently the retina comes to lie outside the focus of the dioptric system, and the image of an object, the rays of light coming from which are parallel, is formed in front of it. This anomaly is known as *myopia*, or short sight (*see* Fig. 91 *c*).

Myopia.

Diagnosis of anomalies of refraction.

The diagnosis of anomalies of refraction can be made by trial with lenses, or by *direct* ophthalmoscopic examination. If we wish to diagnose and measure the degree of anomalies of refraction by trial with lenses we must be provided with a set of trial glasses and a book of Snellen's test types (see p. 305).

[1] It is generally believed amongst English, and is also reported by continental ophthalmologists, that in this country hypermetropia is of more frequent occurrence than myopia. It appears to me that the reverse may obtain. We are rarely in hospital practice consulted about slight myopia, as it gives no inconvenience. On the other hand, a very slight degree of hypermetropia may incapacitate the sempstress, skilled mechanic, or clerk, so that whereas we get all degrees of hypermetropia, we are only applied to in the higher degrees of myopia.

[2] In these diagrams ϕ'' shows posterior focal points of the dioptric system—*j* in *b* and *c* the abnormal position of the retina.

The trial glasses, which are now coming very generally into use, are arranged according to what is known as the "metrical system." The unit in this system is a lens of one metre focal length; it is called a "dioptric" (=D). A lens of two dioptrics is double the strength of that of one dioptric, and has a focal length of half a metre (fifty centimètres), and so on. The box of trial glasses contains convex and concave spherical and cylindrical lenses. It can be obtained from any good optician. Metrical lenses. Dioptric.

We test refraction with lenses as follows:—Having placed our patient at 6 metres from the sheet on which are printed letters from D=6[1] to D=60, we direct him to look towards it. Should he be hypermetropic he will be able to make out all or most of the letters; he will already have told us that he cannot see to do near work or read for any length of time without the eyes becoming fatigued and vision growing misty. We ascertain how many of the letters can be read by each eye separately. Should both eyes read the same letters, we hold before them convex glasses, beginning with +1 D, and continue the trial until we have ascertained *the strongest convex* lens with which the greatest attainable acuteness of vision is still maintained. Thus, supposing our patient reads D=6 at 6 metres, we find the strongest convex lens with which he can still read D=6; should he read D=12 without a convex lens, and D=6 by the aid of one, we find the strongest with which he can still read D=6; if we cannot improve vision, so that he reads more than D=12, we find the strongest convex glass with which he can still read D=12, and so on. Should there be a difference between the two eyes, we must test the refraction of each separately, keeping one covered during the trial of the other. The strongest convex lens which still allows the patient to see as well at a distance as is possible, either with or without the aid of glasses, shows a part of the accommodative power which he was obliged to exercise in order to bring parallel rays of light to a focus upon the retina of his too short eye. The employment of such a lens prevents this waste of accommodation, and reserves it, to be used when required for near work. Test of refraction by lenses. Hypermetropia.

Should our patient be myopic, he will probably tell us that he is near-sighted; he will make out but few or none of the letters at 6 metres; if the small types be given him to read, he will hold them near the eyes, but will make out the smallest, provided the book be held close enough. Myopia.

We notice at what distance the small types can be read by each eye separately, and, as in hypermetropia, if there be no difference between the two test their refraction together.

We tell our patient to look towards the sheet on which are the letters from D=6 to D=60, and hold before his eyes concave lenses beginning with that the negative focal length of which corresponds to the distance at which small types are read.

Thus, if the small types can be read at twenty centimètres, we begin the trial with a lens of 5 D, the negative focal length of which is twenty centimètres.

We continue the trial until we have found the *weakest concave* lens with which distant letters can be most plainly seen. Should our patient

[1] The smaller letters D=5, D=4, D=3, &c., placed at their proper distances, will do equally well if we have not a distance of 6 metres at disposal.

by the aid of any concave lens be able to read D=6 at 6 metres, we find the *weakest* with which D=6 can still be read. Should he be able only to make out D=24, D=12, &c., we must still find the weakest concave lens with which the best vision is attainable.

As in hypermetropia, should there be a difference between the two eyes, we test each eye separately

We must be careful to ascertain *the weakest* lens with which the best vision for distant letters is attainable, because we wish only to so open out the pencil of parallel rays of light as to allow of their being brought to a focus in the retina of the too long eyeball.

If we give too strong a lens our patient will see equally well; but then we have opened out the pencil of parallel rays too much, and he must use his accommodative power in order to overcome the excessive divergence.

Diagnosis by the ophthalmoscope.

In the diagnosis and measurement of anomalies of refraction by direct ophthalmoscopic examination we act upon the same principles as in the diagnosis by trial with lenses; with this exception, however, that we use our own eye as a test, instead of the patient's vision.

As stated at p. 294, nothing of the details of the fundus of the emmetropic eye can be *clearly* made out until we have approached it very near. Now, on the contrary, should any object occupying the fundus be *clearly seen*, whilst we are still separated from the observed eye by a considerable interval, we may be certain that we have to deal with an anomaly of refraction.

Portion of image.

The question now arises, Is the case one of hypermetropia or myopia? We answer the question by ascertaining whether the object we see is viewed in an erect or inverted position. If the former, the eye is hypermetropic, if the latter, it is myopic. We can ascertain the position of the image by moving our head from side to side. If the image be erect, it will move in the same, if inverted, in an opposite, direction to the movements of the head.

Measurement of degrees of ametropia by the ophthalmoscope.

If we wish to ascertain the amount of hypermetropia or myopia present, we take one of the ophthalmoscopes mentioned below; go as close as possible to the patient's eye, revolve the lens containing discs placed at the back of the instrument until we have ascertained, in hypermetropia, the strongest convex, in myopia, the weakest concave, lens with which we can still see clearly the optic disc and retinal vessels.

The number of dioptrics of the strongest convex or weakest concave lens with which the greatest attainable acuteness of vision *for distant letters* is still maintained, expresses what is known as the degree of "ametropia." Thus, we say that an eye which sees as clearly or more clearly through a convex lens of two dioptrics has a hypermetropia of 2 D, an eye of which the acuteness of vision is most improved by a concave of lens of three dioptrics has a myopia of 3 D, and so on.

The same holds good in the measurement of anomalies of refraction by the ophthalmoscope. The strongest convex lens in a case of hypermetropia, the weakest concave in one of myopia, through which a clear view of the fundus can still be obtained, expresses the degree of "ametropia" present.

Oldham's ophthalmoscope.

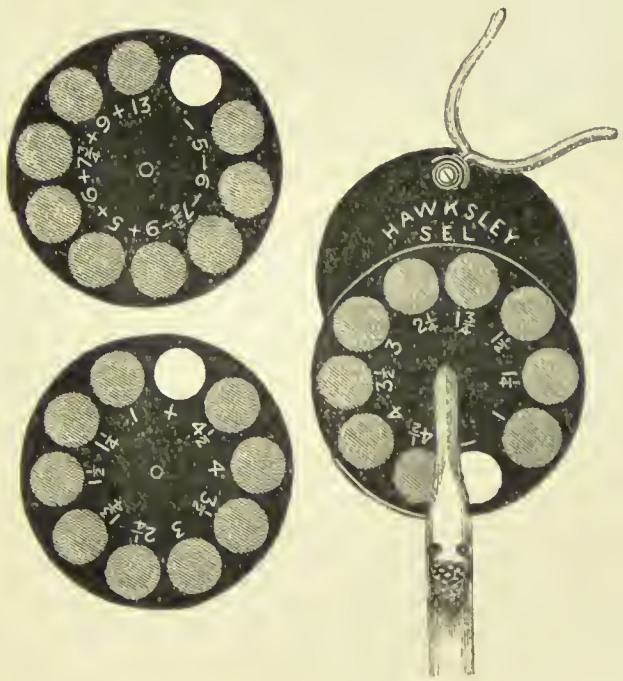
Two very useful ophthalmoscopes, by means of which anomalies of refraction can not only be diagnosed, but also accurately measured, have been devised, one (Fig. 92) by Mr. Charles J. Oldham, of Brighton (*see*

'Report of Fourth Ophthalmic Congress,' 1872), and another by Mr. W. L. Purves; the latter is, I think, the more convenient of the two.[1]

The TREATMENT of anomalies of refraction consists mainly in neutralising the defect by suitable spherical lenses. We must, however, in myopia take care not to give too strong glasses.

For further information on the subject of refraction the reader is referred to works treating specially of ophthalmic subjects, more especially to that on 'The Accommodation and Refraction of the Eye' (Donders).

FIG. 92.



Oldham's ophthalmoscope

Accommodation.

By accommodation is meant the power which the eye possesses of altering the condition of its refractive media, so as to form upon the retina images of near objects, the rays of light from which are divergent, equally as distinct as images of more distant ones, the rays of light from which are parallel, or nearly so. Accommodation.

The power of accommodation depends upon the elasticity of the crystalline lens, the curvature of which can be increased to a considerable extent; the alteration of curvature is brought about by the action of a ring of inorganic muscular fibres, situated between the sclerotic and choroid, just external to the greater circumference of the iris. This ring is known as the *ciliary muscle*. The manner in which the ciliary muscle acts upon the lens is as yet a disputed point, one theory being that the lens is maintained in a flattened condition by tension Ciliary muscle.

[1] Many other refraction ophthalmoscopes are in use, but the two mentioned and another smaller and cheaper instrument, known as Loring's ophthalmoscope, will be found as useful as any.

Mechanism of accommodation.

of its suspensory ligament so long as the eye is adjusted for a distant object; that upon accommodation for a near one the ligament is relaxed by contraction of the muscle, and the curvature of the lens (more especially that of its anterior surface) increased by virtue of its own elasticity. The other theory is that the ciliary muscle compresses the lens in some manner, and so alters its curvature.

Range of Accommodation.

Range of accommodation.

We speak of the range of accommodation, and by it we mean the power of a lens, which we suppose the crystalline adds to itself when we change our look from the farthest to the nearest point of distinct vision. Thus, an eye which sees clearly at infinite distance, when its accommodation is relaxed, and at 16 centimètres with greatest tension of accommodation, has a range or "amplitude" of accommodation equal to a lens of $\frac{100}{16} = 6$ D about.

Accommodation is accompanied by convergence of the optic axes from the action of the internal recti muscles and by contraction of the pupil.

Diseases of Accommodation.

Paralysis of accommodation.

Paralysis of accommodation is met with in cases of paralysis of the third nerve, accompanied by ptosis, divergent strabismus, and more or less dilatation of the pupil; it may be caused by injuries, as blows on the eyeball itself or in its vicinity; sometimes it is met with without apparent cause, not unfrequently in persons recovering from diphtheria, or from any exhausting disease, and accompanied by no paralysis of the external ocular muscles; it can always be produced artificially by the use of atropine.

Symptoms.—Dilatation of the pupil, general mistiness of vision, and inability to see near objects plainly, the last condition being capable of correction by the use of a convex lens.

Treatment.—This depends on the cause; if the paralysis of accommodation be associated with paralysis of other branches of the third nerve, the treatment must be directed against any existing constitutional condition—syphilis, rheumatism, &c.—most improvement being brought about by the use of iodide of potassium in increasing doses, alone or in conjunction with bichloride of mercury. If dependent on injury, the eye should be kept bound up, and inflammatory symptoms treated as they arise. If arising idiopathically, without apparent cause, Calabar bean[1] should be used two or three times a week, in order to stimulate the ciliary muscle to contract, and attention paid to the general health. In any case a convex lens may be used if required.

Spasm of accommodation.

Spasm of accommodation is met with in some cases of hypermetropia, and occasionally in myopia; it often masks a considerable amount of hypermetropia, and may at times even make the eye appear to be myopic. If it exists with myopia, the degree of short sight is increased.

Symptoms.—Severe and constant pain in the eyeballs and forehead, increased on any attempt to use the eyes, and associated with some anomaly of refraction (generally hypermetropia), inability to see near or distant objects distinctly, these symptoms being modified or entirely removed by the use of atropine.

[1] The Calabar gelatine was the most convenient form for application, but recently a solution gr. iv to ℥j of sulphate of eserine (an alkaloid obtained from Calabar bean) has been employed with the best results.

TREATMENT.—Paralyse the accommodation by the constant use of a strong solution of atropine (gr. iv of sulphate of atropia to ℥j of water), and accurately neutralise any existing anomaly of refraction by suitable lenses.

Acuteness of Vision.

By acuteness of vision we understand the perceptive and conductive power of the structures concerned in sight; this may be ascertained by the use of test types; *i.e.* letters of certain definite proportions, which can be recognised by a fairly sharp-sighted eye at certain distances, which distances are marked over each set of letters.

Snellen's types.

The book of test types we use is that of Dr. Snellen; in it we find types variously numbered from ·5 to 60, the former being ·5 of a metre, or 50 centimètres, the latter 60 metres, at which distances the types can be read by an emmetropic eye of normally acute vision. The book of types can be obtained of Williams and Norgate, Henrietta Street, Covent Garden.

Field of Vision.

Field of vision.

By the field of vision we understand the area over which objects situated in the same vertical plane can be distinguished, the eye being kept fixed on some point. The limits of the field of vision are marked by the most excentrically placed points of objects, which can still be distinguished, the direction of the visual axis of the eye being unaltered.

Mode of ascertaining the extent of the visual field :—The extent of the visual field is easily measured by either of the two following methods:

Examination of field of vision.

1. The patient being placed at a distance of twelve inches from a black board about three feet square, having a white cross in its centre, should be directed to look steadily at the cross, which must be situated on a level with the eyes; one eye being closed, the sensibility of the retina of the other should be tested by moving a piece of chalk fixed on a dark handle from all directions towards the cross, a mark being made at the point where the chalk first becomes visible.

With black board.

The whole area limited excentrically by a line joining the points at which the chalk is first seen when approaching from every direction is known as the *quantitative field* of vision, in contra-distinction to an area bounded excentrically by much narrower limits, over which objects are distinctly defined, and letters can be read, &c., known as *the qualitative field of vision.*

2. Another very simple and effectual method of investigating the condition of the visual field is conducted as follows:

By comparison with healthy eye.

Having placed the patient in a convenient position, we stand opposite to him, at a distance of about two feet, and, supposing his left eye to be examined, we direct him to look steadily at our right eye, which is opposite to his left; the patient's right eye and our left being kept closed, we then move our hand in various directions in the peripheral parts of the field, and notice if its movements are perceived by the patient at the same distance from the centre as by our own healthy retina.

Care must be taken that the hand is moved in a vertical plane situated midway between our own and the patient's eye, and not nearer

one than the other; we must also take care that he keeps his eye fixed.

Normal extent of field.

Supposing that the eye under examination distinguishes all movements of the hand at the same distance from the centre as our own, we decide that his field of vision is normal; but if a falling off is noticed in any particular direction, we infer that the sensibility of the corresponding portion of retina is impaired.

It must be remembered that each part of the visual field corresponds to a part of the retina opposite to, and not on the same side as, the object seen; *e.g.*, suppose that the movements of the hand are not perceived in the outer half of the field, the inner half of the retina is defective, and *vice versâ*.

Limitation of field of vision.

It must also be borne in mind that the height of the bridge of the nose has a considerable influence in limiting the inner half of the visual field. Limitation or contraction of the visual field is a very constant accompaniment of retinal changes; it is also one of the earliest symptoms of glaucoma, and occurs as a physiological condition with advancing age.

Towne's stereoscopic test for the retina.

Stereoscopic test for the retina.—A very simple and effectual method of testing the sensibility of the retina has been devised by Mr. Joseph Towne, of Guy's Hospital: it consists in presenting simultaneously to non-corresponding halves of the two retinæ similar objects.

The examination is carried out by means of a stereoscope, provided with two slides; on each slide are two white semicircles described upon a red ground, those on the one slide being so contrived that when looked at through the stereoscope they correspond to the nasal halves of the two retinæ, whilst those on the other slide correspond to the two malar halves. In cases of want of sensibility of the whole or any part of the retina, from whatever cause arising, a part or the whole of one or both semicircles corresponding to the affected portion of retina appears misty or entirely obscured. The degree and extent of the mistiness or obscurity is governed by the degree of insensibility and extent of the impaired portion of retina. Mr. Towne has made "The Stereoscopic Test for the Retina" the subject of some very interesting papers in 'Guy's Hospital Reports,' series iii, vols. xi, xii, xiv, xv.

DISEASES AND INJURIES OF THE EYEBALL AND ITS APPENDAGES.

Several of the more important affections of the organ of vision will be briefly alluded to in future pages; the present section is devoted to a short description of those diseases and injuries which (with a few exceptions, *e.g.* glaucoma) do not call for operative interference.

THE EYELIDS.

Eyelids.

Congenital anomalies.

Congenital anomalies.—Absence of the eyelids; a failure of closure of the fœtal fissure, leaving a cleft in one or both lids (coloboma); ptosis, complete or partial; development of a third lid; pigment spots, moles, nævi, and warty growths, have all been occasionally met with.

Ulcers.—Simple ulcers, venereal sores (chancres), syphilitic, and cancerous ulceration, are sometimes met with. The first three require to be treated on general medical principles; the last by operation, if the disease has not proceeded too far. Ulcers.

Phthiriasis.—The pediculus pubis (crab louse) is sometimes found amongst the eyelashes close to the margin of the lids. The edges of the lids appear to be covered with scabs and crusts somewhat resembling tinea; on close examination the insects themselves will be discovered adhering closely to the margin of the lids, their eggs being attached to the lashes near their bases. Lice.

TREATMENT.—The daily use of some kind of mercurial preparation, none being better than the Ung. Hydrarg. Ammoniatum.

Paralysis of the orbicularis muscle occurs in some cases of facial paralysis; there is inability to close the eye, the lower lid falls away from the globe, there is considerable collection of lachrymal secretion at the inner canthus, and constant watering of the eye consequent on the displacement of the lower tear punctum. Affections of orbicularis muscle.

TREATMENT.—General medical treatment should be adopted.

Spasm of the orbicularis muscle may occur from long-continued intolerance of light, consequent on affections of the cornea. Spasm.

TREATMENT must be directed against the corneal affection. (*See* Diseases of the Cornea.)

Spontaneous twitching, more especially of the lower lid, popularly known as "live blood," is met with in some cases of hypermetropia, or in persons whose digestions are out of order; it is very probably a symptom of undue contraction of the ciliary muscle.

TREATMENT.—Correction of existing hypermetropia, instillation of atropine, and attention to the general health.

Inflammation of the eyelids may occur during or after acute diseases (measles, scarlatina, &c.), in the course of erysipelas, as the result of injuries, or in connection with severe inflammation of neighbouring parts, *e.g.* purulent ophthalmia. The swelling and redness are usually considerable, and the eye cannot be opened; the inflammation generally ends in resolution, but may (especially if it result from measles, scarlatina, &c.) go on to the formation of abscess, or even to sloughing of the skin. Inflammation of eyelids.

TREATMENT.—Locally, fomentations with hot water or decoction of poppy heads; if an abscess form, it should be opened—preferably through the conjunctiva.

The patient's general health should also be attended to.

Stye ("**hordeolum**") is a small red and painful swelling situated on the outer surface of the lid, or near its margin, and consists in a circumscribed inflammation of the lid, dependent on morbid change in the Meibomian glands. Styes generally occur in weakly delicate persons; several may appear simultaneously, or there may be a succession of them; they give rise to considerable irritation and are often extremely painful. The inflammation usually goes on to suppuration. Stye.

TREATMENT.—Fomentations, poultices, the administration of tonics, and good living. When pus has formed, the little tumours should be opened.

Tinea (ophthalmia tarsi).

Patients suffering from tinea present themselves with yellowish- Tinea.

brown dry crusts hanging to the eyelashes, which have often dropped out to a considerable extent.

Displacement of tear puncta.

In old cases the margins of the lids are much thickened, giving rise to displacement of the tear puncta and consequent watering of the eye; on removing the crusts the margin of the lid will be found ulcerated, fissured, and easily bleeding. The disease consists in inflammation and ulceration about the roots of the lashes; it runs a very chronic course, often lasting for years in spite of remedies.

Treatment.—Slight cases can generally be cured by the use of a lotion containing 4 to 6 grains of alum to the ounce of water, applied three or four times a day, and of mild nitrate of mercury ointment (one part of the ordinary nitrate of mercury ointment to eleven of lard),[1] smeared along the margins of the lids night and morning.

The patient should be directed to remove all the crusts before applying the ointment.

More severe cases should be treated by pulling out the lashes and removing the scabs with forceps, and then applying solid nitrate of silver to the raw surface left.

Wounds.

Injuries.—Wounds of the eyelids, however extensive or ragged, should, after having been thoroughly cleansed, be brought accurately together; they will usually heal readily enough. Should there be any loss of substance, an endeavour must be made to prevent distortion of the lids by contraction of the resulting cicatrix.

Ecchymosis.

Ecchymosis of the lids (black eye) frequently occurs as the result of blows, and may be caused by leech bites or operations.

Treatment.—Most cases may be left alone, but if it is desirable to get quickly rid of the effused blood, a poultice made of equal parts of the scraped root of black bryony and bread crumbs should be applied. The poultice should be kept on as long as the patient can bear it. The application is often accompanied by a good deal of stinging pain.

Emphysema.

Emphysema of the lids sometimes occurs from rupture of the mucous membrane of the nose, air being forced into the cellular tissue of the eyelids, on sneezing, or blowing the nose. Gentle pressure with cotton wool and a bandage, and avoidance of violent expiratory movements, sneezing, &c., is the only treatment required.

Lachrymal apparatus.

The lachrymal apparatus.—The principal affections of the tear passages, &c., will be described in the next section.

THE CONJUNCTIVA.

Ophthalmia

Ophthalmia.—Under this head are collected all the different forms of inflammation of the conjunctiva. The following characters are common to all; more or less vascularity of the membrane, uneasiness and stiffness of the lids, pain of a smarting character, some kind of discharge, and gumming together of the lids during sleep.

Characteristics.

Inflammation of the conjunctiva has to be distinguished from inflammation of the sclerotic or subconjunctival fascia, or the injection of these structures which is present in many of the inflammations of deeper parts of the globe. The distinction can be made by paying attention to the following points:

Diagnosis.

1. The inflamed conjunctiva is bright red, the vessels are large and tortuous, and anastomose freely, forming a dense network;

[1] The ointments employed in the ophthalmic department at Guy's Hospital are now almost invariably prepared with vaseline instead of lard.

they are of greater calibre about the fornix, and taper off towards the cornea.

The inflamed sclerotic or episcleral tissue is pinkish or bluish in colour; the vessels are small and straight, and the vascularity is usually most marked in a ring around the eyeball, just external to the corneal margin.

2. The vessels of the conjunctiva can be somewhat displaced, and made to glide over the surface of the eyeball by gentle pressure; those situated in deeper parts cannot be made to alter their positions.

3. The pain in inflammation of the conjunctiva is of a smarting character; while in inflammations of deeper parts it is dull and aching, and often very severe.

Treatment. Treatment.—Inflammations of the conjunctiva are best treated by astringent applications.

Any of the following formulæ may be employed:

Astringent applications.

Strong Alum Lotion.

Alum, gr. x; water, ℥j.

Useful in cases of purulent ophthalmia.

Alum Lotion.

Alum, grs. iv to vj; Water, ℥j.

Sulphate of Copper Drops.

Sulphate of copper, gr. ij; Water, ℥j.

Sulphate of Zinc Drops.

Sulphate of zinc, gr. ij; Water, ℥j.

Nitrate of Silver Drops.

Nitrate of silver, gr. j; Water, ℥j.

Chloride of Zinc Drops.

Chloride of zinc, gr. ij; Water, ℥j.

Most useful in cases of chronic ophthalmia.

Atropine and Astringent Solution.

Sulphate of atropia, gr. ½ to gr. ij; Sulphate or chloride of zinc, gr. ij; Water, ℥j.

Useful in cases where iritis or corneitis occurs in the course of ophthalmia.

Any of these remedies may be given to the patient to use himself; they should be applied from three to six times a day, or oftener, and the patient should be directed to wash away all discharge before using any of them, and to take care that the lotion goes well between the lids.

Some kind of ointment (spermaceti, mild nitrate of mercury, &c.) should also be ordered to be smeared on the margins of the lids at night, to prevent their becoming gummed together during sleep.

The condition of the patient's general health should also be attended to.

Other applications, which should be used by the surgeon himself are—

Mitigated nitrate of silver stick. Green stone.

The mitigated nitrate of silver stick (consisting of nitrate of potash and nitrate of silver, in the proportion of three parts of the former to one of the latter).—*Green stone—lapis divinus* (consisting of equal parts of alum, nitrate of potash, and sulphate of copper, with a small

Application of green stone, &c.

quantity of camphor), and *solid nitrate of silver*. In order to apply any of these the patient should be seated in a chair, and the surgeon standing behind, as in Fig. 93, p. 340; should evert the lids and lightly rub their conjunctival surface with either. If a preparation of nitrate of silver be employed, the conjunctiva should be washed with salt and water immediately after the application.

Varieties of Ophthalmia.

Catarrhal ophthalmia.

Catarrhal ophthalmia is commonly caused by draughts of cold air is highly contagious, and acute in its course.

The conjunctiva, both ocular and palpebral, is highly injected, and sometimes swollen; there may be small extravasations of blood in the structure of the former; there is a thick, yellow, tenacious discharge.

One or both eyes may be affected, the disease usually commencing in one, and spreading to the other in the course of two or three days.

TREATMENT in the early stages, before there is any amount of discharge.—Some soothing application (as decoction of poppy-heads) should be employed; later on, an astringent should be used, and some mild nitrate of mercury or spermaceti ointment smeared on the edges of the lids at bed-time, to prevent their becoming gummed together during sleep.

The patient (or, in the case of a child, its parents) should be warned of the contagious nature of the disease, and no sponges, towels, &c., which he is in the habit of using, should be used by other people. Among the poorer classes it is very common to see a whole family suffering from catarrhal ophthalmia.

Chronic ophthalmia.

Chronic ophthalmia is usually a sequel of some more acute form; the palpebral conjunctiva is reddened, the ocular conjunctiva presenting patches of slightly increased vascularity, but no general redness, as in cases of catarrhal ophthalmia; the lids are often somewhat thickened, and the caruncle and semilunar fold swollen. There is slight mucous discharge, which forms dry crusts on the margins of the lids, and, at the inner canthus, overflow of tears may occur from obstruction or displacement of the tear puncta.

TREATMENT, the same as that of catarrhal ophthalmia. The disease may continue for almost any time, and when one remedy appears to have lost its effect another should be tried.

Phlyctenular ophthalmia.

Phlyctenular ophthalmia, usually met with in children and young adults, especially females, is characterised by the existence of small whitish elevations on the conjunctiva, most commonly near the margin of the cornea; each little elevation has a wisp of blood-vessels leading to it if near the corneal margin, and is surrounded by a zone of vascularity if situated in any other part of the conjunctiva. There is some watering of the eye and slight mucous discharge.

Patients are frequently met with who suffer from repeated attacks of phlyctenular ophthalmia.

TREATMENT.—In treating phlyctenular ophthalmia our object is to set up a certain amount of irritation of the conjunctiva, by which the phlyctenulæ will be destroyed. This can be attained by dusting calomel into the eye daily, or by ordering a small quantity of an oint-

ment containing 2 grs. of yellow oxide of mercury to 5j of lard or vaseline, to be applied to the inner surface of the lower lid at bed-time. Either of these remedies will soon cause the phlyctenulæ to disappear. The disease, as affecting the conjunctiva covering the cornea, will be spoken of under diseases of that structure. Tonics should be given if required. Yellow oxide of mercury ointment.

Granular ophthalmia.—This disease occurs at all ages, and is very common amongst the lower classes, especially the Irish; it is highly contagious. Granular ophthalmia is often very prevalent where large numbers of persons are crowded together in workhouses, parish schools, barracks, &c. It would appear that in those who have lived for a considerable time under unfavorable hygienic conditions, a peculiar granular state of the palpebral conjunctiva becomes developed. Persons thus affected are said to be predisposed to granular ophthalmia. The predisposed eyelid is characterised by the existence of small pale spherical bodies, situated in the structure of the conjunctiva; the little bodies much resemble and are known as sago grains; they are most constantly found upon the lower lid near the outer canthus. Granular ophthalmia. Predisposed eyelid.

This predisposed or granular condition of the eyelids may remain stationary for an unlimited time without giving rise to inconvenience; but on the other hand, attacks of inflammation are ever liable to be set up, giving rise to the development of granular ophthalmia as we see it in practice.

We meet with three principal forms of granular ophthalmia, which may be distinguished from each other by the nature of the granulations present.

One characterised by the predominance of the sago grains already alluded to, around which inflammation has been set up, is known as follicular granulation.

Another form, characterised by the predominance of hypertrophied papillæ, by which the sago grains if they exist are obscured, is known as papillary granulation. A third form, characterised by a mixture of follicular granulations and hypertrophied papillæ, is known as mixed granulation; this is the most severe form of the three. Follicular granulations. Papillary granulations. Mixed granulation.

In old cases, and especially those that have been treated by strong caustics, the conjunctiva may be found converted into a mass of rough harsh cicatrices, and its secreting power destroyed, the condition known as "xerophthalmia" being developed. Xerophthalmia.

Granulations in active granular ophthalmia, unlike the sago grains which characterise the predisposed lid, are always found most developed on the conjunctiva covering the attached border of the tarsal cartilage of the upper lid. Their appearance is more or less altered by treatment; they are accompanied by thick yellow discharge, and there may be more or less severe intolerance of light.

Sequelæ of granular ophthalmia.—The cornea may become more or less opaque and vascular, especially at its upper part; the condition is known as "pannus," and is caused by constant irritation of the cornea by the rough surface of the lid. Sequelæ. Pannus.

The conjunctiva may be destroyed to a greater or less degree, extensive cicatrices being formed, which, by their contraction, cause shrinking of the membrane and distortion of the lids, giving rise to entropion and narrowing of the palpebral aperture. The hair bulbs may become displaced, causing the eyelashes to be misdirected— Destruction of conjunctiva. Entropion.

Trichiasis. "trichiasis" (see p. 343). The results of granular ophthalmia are frequently aggravated by unskilful treatment.

Treatment. TREATMENT.—In treating granular ophthalmia our object is to destroy the granulations, with as little damage as possible to the conjunctiva itself.

Avoidance of strong caustics. *The use of strong caustics must be carefully avoided,* as they cause too much destruction of tissue, followed by the formation and subsequent contraction of cicatrices.

Slight cases can be cured in a short time by the application of mitigated nitrate of silver stick twice a week, or oftener, and the use of sulphate of copper drops from three to six times a day.

Duration of attack. More severe cases will remain under treatment for months or years, but if persevered with will usually get well. If the ophthalmia be of recent date the granulations should be touched twice a week with the mitigated nitrate of silver stick, or, if possible, every day, sulphate of copper drops being used from three to six times daily.

In chronic cases the green stone should be used instead of the nitrate of silver stick.

The application of calomel powder or quinine to the granulations has also been found useful in some cases.

Inoculation. When the cornea is completely opaque and fleshy looking, inoculation with pus from a case of purulent ophthalmia may be tried, but only in extreme cases, otherwise we may do more harm than good by causing sloughing of the cornea; should but one eye be affected, care must be taken to prevent the other becoming inoculated.

Occurrence of iritis. Iritis not unfrequently supervenes in the course of granular ophthalmia; when it occurs a solution of atropine should be dropped into the eye from three to six times daily, in addition to other remedies.

Pannus requires no special treatment, and if not very dense disappears as the granulations are cured. In all cases some simple ointment should be applied to the edges of the lids at night, to prevent their becoming gummed together.

Purulent ophthalmia. **Purulent ophthalmia.**—Purulent ophthalmia may be met with, as "ophthalmia neonatorum" in children soon after birth, or in older persons. In the former case it may be caused by contact of acrid vaginal secretions, by want of cleanliness and fresh air, or a combination of the two; in the latter by contact with some form of specific pus, or by constant irritation of the already inflamed conjunctiva. It is highly contagious.

Gonorrhœal ophthalmia. The worst form of the disease, whether occurring in infants or older persons, is that caused by inoculation with gonorrhœal matter—"gonorrhœal ophthalmia."

Ophthalmia neonatorum. "Ophthalmia neonatorum" makes its appearance a few days after birth; the eyelids are found red or bluish-red and swollen; the eyes can only be opened with difficulty, and on attempting to separate the lids thick yellow purulent discharge escapes from between their edges; both eyes are almost always affected.

Purulent ophthalmia in older persons may affect one or both eyes; it commences with intolerance of light, lachrymation, and injection of the conjunctiva, at first much resembling an ordinary attack of catarrhal ophthalmia, but in about twelve hours its real nature becomes apparent by thick yellow discharge from between the

swollen, red, and sometimes everted lids. The conjunctiva is bright scarlet, traversed by large distended blood-vessels, and much swollen, especially the ocular portion (chemosis), which may overlap the cornea and protrude in folds between the lids; there is pain and intolerance of light; and there may be much depression, especially if the attack have lasted long. The patient may be suffering from gonorrhœa. The great danger to be feared in purulent ophthalmia is implication of the cornea, which may be partially or entirely destroyed by suppuration or sloughing. Chemosis. Implication of cornea.

Treatment.—In all cases the patients themselves or their parents should be warned of the contagious nature of the disease, and if one eye only be affected the greatest care should be taken to protect the other. If possible, a good view of the cornea should be obtained, as its condition materially influences the prognosis with regard to sight. The examination should be made with care, as the cornea may be ruptured whilst making it. Treatment.

In ophthalmia neonatorum the only treatment required is to wash out the eyes every hour or half hour with strong alum lotion (see p. 309) until the discharge is lessened; the lotion need only be used thus frequently for twelve hours out of twenty-four (from 8 a.m. to 8 p.m.), the child being allowed to sleep at night; as the discharge gets less the lotion may be used less frequently. Some simple ointment should be applied to the margins of the lids once or twice a day to keep them from sticking together.

Slight cases of purulent ophthalmia in older persons may be treated in the same manner, but the more severe forms (especially the gonorrhœal) require that much more energetic measures be taken.

The treatment should be both local and constitutional.

Local treatment.—When the patient is first seen the lids should be everted, and the whole conjunctiva brushed over with a stick of solid nitrate of silver, or painted with a solution of 40 to 60 grains of the salt to ℥j of water; the application should be repeated in the course of two or three days if no improvement have taken place. The patient should be kept lying down in a dark room, and a bag of ice, or lint kept wetted with iced water, applied over the closed lids; the ice or lint should be removed and the eyes washed out every hour or half hour with some astringent lotion, the greatest cleanliness being observed. Application of nitrate of silver.

Should there be much pain, and the patient be strong, blood may be taken from the temples by leeches or the application of the artificial leech, but, as before stated, most patients suffering from severe purulent ophthalmia are much depressed and will not bear depletion. Abstraction of blood.

Constitutional treatment.—The free administration of tonics, especially iron and quinine, with good living, and a fair amount of stimulants. Constitutional treatment.

If perforation of the cornea threaten or have taken place, the eye should be kept firmly bandaged, so as to prevent as much as possible any escape of the contents of the globe.

Diphtheritic ophthalmia.—This form of ophthalmia is but rarely met with in London; it affects persons of all ages. At first sight the case appears to be one of severe purulent ophthalmia; its chief characteristic, however, is a solid infiltration of the substance of the conjunctiva, with or without the formation of diphtheritic membranes on Diphtheritic ophthalmia.

its surface. The affected eye is frequently lost from implication of the cornea. The disease is best treated by sedative applications, as fomentations of poppy heads, or belladonna, attention being paid to the patient's general health.

Injuries. **Injuries.**—Wounds of the conjunctiva usually heal readily enough, requiring only simple treatment.

Burns. *Burns* are usually caused by contact of lime or hot metals; the damage done may be only slight, or the whole conjunctiva and cornea may be converted into a dead white slough.

Treatment. TREATMENT.—The conjunctiva should be carefully examined, and all foreign bodies and portions of sloughy tissue removed; should the injury have been caused by lime the surface of the conjunctiva must be carefully cleansed with a weak solution of acetic acid or simple warm water. Some oil should be placed between the lids, and the eye bound up with wet lint and a bandage. If any symptoms of iritis appear, a solution of atropine should be dropped into the eye from three to six times a day. Should there be much discharge alum lotion may be used.

Prevention of adhesions. When the sloughs have separated care must be taken to prevent adhesions between the raw surfaces left, by passing a probe between the lids and eyeball once or twice a day, and directing the patient to draw the lid away from the globe frequently.

Foreign bodies. *Foreign bodies*, small pieces of coal, iron, &c., are sometimes found embedded in the conjunctiva, and must be removed.

Hæmorrhage. *Hæmorrhage* into the substance of the conjunctiva or beneath it may occur spontaneously, or from injury; no treatment is necessary; the patient may be assured that no harm will come of it, and that the blood will disappear in the course of a week or longer.

External muscles.

EXTERNAL MUSCLES OF THE EYEBALL.

Strabismus will be considered in the next section.

Nystagmus. **Nystagmus** signifies a peculiar involuntary quivering motion of both eyes, dependent on rapid contraction of antagonistic pairs of muscles. The disease is usually developed in infancy, and is always associated with considerable impairment of vision, arising from congenital cataract, opacity of the cornea after purulent ophthalmia, atrophy of choroid, &c.

TREATMENT.—Nothing can be done to remedy nystagmus.

Paralysis and paresis. **Paralysis and paresis.**

Paralysis signifies total loss of power of the affected muscle; paresis, only partial loss.

Symptoms. The symptoms of paralysis and paresis are double vision and total loss, or impairment of mobility of the eye in some particular direction.

The causes are affections of the brain or spinal cord; diseases within the orbit, as tumours, or inflammatory affections, pressing on the nerves supplying the muscles, and affections of the nerves themselves or of the muscles. As a rule, the cause of the paralysis or paresis can only be conjectured, but very many cases will be found connected with syphilitic diseases.

Treatment. TREATMENT.—A careful inquiry should be made into the patient's previous history, and remedies given in accordance with this, those of an antisyphilitic nature being generally required. If the affection

has not lasted more than three months a favorable prognosis may be given, but if, on the contrary, it has existed six months or more, recovery is very improbable.

Insufficiency of the internal recti muscles gives rise to somewhat obscure symptoms, which have been mistaken for manifestations of cerebral disease. Insufficiency of internal recti.

Patients thus affected complain that they cannot do near work for any length of time, as objects looked at become indistinct, or appear double. They suffer from giddiness, and pain in the brows and head generally. Insufficiency of the internal recti should always be suspected if in a case of hypermetropia relief cannot be given by the use of glasses.

TREATMENT.—Any anomaly of refraction should be accurately neutralized, and the weakened muscles assisted by the use of prisms or of spherical lenses so arranged as to have a prismatic action. Treatment.

THE CORNEA.

Inflammation (corneitis, or keratitis).—Five different forms of inflammation of the cornea are met with:—(1) Simple corneitis, (2) interstitial or parenchymatous corneitis, (3) pustular corneitis, (4) keratitis punctata, (5) corneitis with sloughing or suppuration. Corneitis.

Symptoms.—Corneitis is characterised by watering of the eye, impairment of vision, intolerance of light, and pain, at times severe, at others insignificant; on examination more or less of the cornea will be found cloudy or quite opaque, and blood-vessels may be seen in its substance or on its surface. Symptoms.

It is of importance to notice the course and position of the blood-vessels in any case where the cornea has become vascular. Should the vessels lie altogether in the cornea, commencing near its margin, and passing for a variable distance in its substance, the case is probably one of interstitial keratitis; but should the vessels be continuous with those of the conjunctiva, pass over the margin of the cornea, and lie superficially on its surface, the vascularity is probably due to mechanical irritation from granular lids or inverted lashes, and the condition known as *pannus* is present. Diagnosis.

It is very necessary that the difference between these two forms of vascularity should be recognised, as their treatment varies widely.

In the former case the treatment of keratitis, to be presently described, should be adopted; in the latter treatment must be directed against the cause of the vascularity (granular lids, &c.).

Simple corneitis may be caused by injuries, or the lodgment of foreign bodies on the surface or in the substance of the cornea. There is some pain, intolerance of light, and lachrymation, and some part of the cornea is found occupied by a halo of dulness. Simple corneitis.

Interstitial or parenchymatous keratitis (corneo-iritis, syphilitic keratitis, keratitis, diffuse keratitis, vascular corneitis). Interstitial keratitis.

Interstitial keratitis occurs in persons who are affected by hereditary syphilis; it is frequently but by no means invariably associated with changes in the teeth, pegged canines, notched incisors, or dome shape of first molars; flattened nose, fissures around the angles of the mouth, or other manifestations of congenital syphilitic disease.

It usually first makes its appearance between the fifth and eighteenth years, but has been seen as late as thirty; it always affects both eyes

either simultaneously or at short intervals; it runs a very chronic course and is most intractable, a severe attack often lasting from twelve to eighteen months.

Symptoms. *Symptoms.*—Interstitial keratitis presents all the symptoms of inflammation of the cornea in a marked degree. The opacity is peculiar, and is caused by infiltration of the substance of the cornea with opaque material.

At first the cornea becomes spotted in its centre, but the spots soon run together, forming a greyish haze; opacity then commences at the upper and lower corneal margins, and gradually spreads, until the whole structure resembles somewhat a piece of ground glass, apparently blood-stained in parts, from the development of innumerable minute blood-vessels. There is always a well-marked band of ciliary injection. Interstitial keratitis is not unfrequently complicated by iritis, hence the name "corneo-iritis."

Recovery. The opacity having reached a certain point, may remain stationary for months, but at length clearing commences, and the cornea regains more or less of its normal transparency; recovery always taking place to a much greater extent than would be at first expected. In some few cases a choroido-iritis is set up, and the eye eventually shrinks.

Pustular corneitis. **Pustular corneitis** (phlyctenular, strumous, vascular, corneitis; strumous ophthalmia, fascicular keratitis).

Pustular corneitis is met with in children and young adults; it often follows measles, scarlatina, or other acute diseases; it is frequently accompanied by eczematous eruptions on the eyelids, about the nostrils and angles of the mouth, and on the head; the patients often present well-marked strumous diatheses, and are generally said to be delicate.

Symptoms. *Symptoms.*—In most cases there is profuse lachrymation, accompanied by great intolerance of light; the lids may be swollen, covered with eczematous eruption, and tightly screwed up, so as to cause the greatest difficulty in examination.

There is more or less injection of the ciliary region (ciliary redness). Upon the surface of the cornea may be found (1) small greyish elevations (phlyctenulæ); (2) phlyctenulæ in a state of suppuration (pustules); (3) small ulcers left on discharge of the contents of the latter. Any of these are usually found in greatest quantity round the margin of the cornea, but its whole surface may be found dotted over with phlyctenulæ, pustules, or ulcers, or examples of all three may be met with in the same eye. There is more or less haziness and vascularity surrounding the affected portions of cornea. In some cases there is thick mucous or muco-purulent discharge in addition to the lachrymation.

Cases of pustular corneitis, accompanied by great intolerance of light, much swelling of the eylids, profuse lachrymation, and thick mucco-purulent discharge, occurring in strumous children, are sometimes described as a separate disease under the name of "strumous ophthalmia."

Strumous ophthalmia.

Fasicular keratitis. Fascicular keratitis is a somewhat rare form of the disease characterised by the existence of a fasciculus of vessels running on to the cornea from its margin, the fasciculus terminating in a small ulcer, phlyctenula, pustule, or small inflamed patch of cornea.

Pustular corneitis is very likely to recur.

Keratitis punctata occurs in young adults, never in children; it much resembles the early stages of interstitial keratitis, and probably arises from the same cause; as a rule, one eye only is affected; there are the usual symptoms of corneitis, but the intolerance of light is not very severe; the cornea is dotted over with small greyish opacities, which are collected most thickly in its central portion, and on careful examination will be found to occupy the posterior layers of the structure. The disease is most intractable, and may be accompanied by iritis. Keratitis punctata.

Corneitis with sloughing or suppuration is usually the result of sharp blows, as flicks from twigs, &c., or is caused by the irritation of foreign bodies, as the husks of corn; it may also occur after operations for cataract. Suppurative corneitis.

Symptoms.—Those of corneitis, severe pain being, as a rule, one of the most marked; some part of the cornea will be found occupied by a collection of pus, part of which may have escaped into the anterior chamber and collected at its lower part, giving rise to the condition known as "hypopyon;" or the pus may have gravitated down between the layers of the cornea to its lower margin, forming a collection much resembling hypopyon and known as "onyx." Suppurative corneitis is met with in cases of *neuro-paralytic ophthalmia;* a peculiar form of inflammation, associated with paralysis of the ophthalmic division of the fifth nerve, and consequent anæsthesia of the parts supplied by it. Hypopyon. Onyx. Neuro-paralytic ophthalmia.

Instead of a collection of pus, some part of the cornea may be found occupied by a dead white slough, or a large ulcerated and sloughing surface.

The iris may also be inflamed and suppurating.

Treatment.—The treatment of corneitis should be both local and constitutional. Treatment.

Local treatment.—All foreign bodies or other sources of irritation should be removed; the eyes must be protected from light by a large shade, protectors, or better still by a bandage. Sedative applications should be employed, none being better than belladonna lotion, containing from 6 to 10 gr. of extract of belladonna to the ounce of water; or, if preferred, a weak solution of atropine, gr. ½ to a pint of water, may be used instead; the eyes should be bathed three or four times a day with either of these, and kept bound up with lint wetted with one or the other. Local. Belladonna lotion.

If iritis exist, a stronger solution of atropine, gr. ½ to gr. ij or iv to the ounce of water, should be dropped into the eyes as often as may appear necessary.

In corneitis with suppuration warm applications will be found most beneficial; the eye should be well bathed with warm belladonna lotion or decoction of poppies several times a day, and bound up firmly with lint, soaked in one or the other. If pain be a prominent symptom it may be greatly relieved by taking blood from the temples. Should a large area of the cornea become infiltrated with pus, a free incision should be made by transfixing with a cataract knife and cutting out obliquely through the centre of the infiltrated portion. Incision.

In cases of corneitis, especially of the interstitial and pustular forms, where there is obstinate intolerance of light, which will not yield to the above treatment, a seton should be placed in the skin of the temple on one or both sides (*see* p. 342). In some cases the spas- Seton.

modic contraction of the orbicularis may be kept up by the irritation of small fissures at the outer canthus; in such a free division of the junction of the lids and orbicularis by cutting through the canthus will often effect a speedy cure.

The inhalation of chloroform is also said to act beneficially in some cases.

Iridectomy. If in a case of suppuration or sloughing perforation of the cornea appear imminent, iridectomy should be performed (*see* p. 359).

Constitutional. *Constitutional treatment.*—Simple corneitis requires no constitutional treatment. In the interstitial form antisyphilitic remedies should be employed; to older patients the bichloride of mercury in doses of one sixteenth to one twelfth of a grain, combined with bark or other tonic, should be given twice or three times a day; to young children hyd. cum cret. gr. j to v three times a day.

The other forms of corneitis, especially the pustular, are best treated by the administration of tonics, as steel wine, tincture of perchloride of iron, quinine, &c.; and in strumous children cod-liver oil should also be prescribed, with good living and plenty of fresh air.

Ulcers of the cornea. **Ulcers of the cornea** present a great variety of forms. They may be transparent or opaque; they may be healing, indolent, vascular, or sloughing. The depth to which the corneal tissue is destroyed varies from slight abrasion of its surface to destruction of its whole thickness, causing perforation. The area of the cornea which is destroyed also varies from a small point to its whole surface.

Ulcers are sometimes described as marginal or central, according to their position. Ulceration of the cornea is constantly met with in cases of debility, from whatever cause arising. It is very common in patients recovering from acute diseases, as measles, scarlatina, and more especially smallpox, from impaired nutrition, not from formation of pustules or eruption on the cornea. Children are much more frequently affected than adults.

The symptoms of ulceration are very similar to those of corneitis. On examination any kind of ulceration may be found (one variety has been mentioned under Pustular corneitis). There may be one or more small *transparent ulcers*, which can only be seen in certain lights, and are very likely to be overlooked. They appear like small abrasions of the epithelium; sometimes the greater part of the surface of the

Transparent ulcer. cornea is found to be affected either by several small transparent ulcers or one large one. This form of ulceration is most commonly met with in adults of irritable, nervous temperament, and should always be carefully looked for when a patient of this description presents himself suffering from severe intolerance of light, watering of the eye, and smarting pain, without any very apparent cause.

Opaque ulcer. *Opaque ulcers* are visible enough; they may be of any size or number. At times they appear to be healing, in which case the edges appear smooth and the surface of the ulcer rough and opaque or cloudy. At others they are indolent, and again they may be spreading, when their edges are found to be clean cut, as if a piece of the cornea had been punched out by some sharp instrument; the surface of the ulcer appears glassy, and is often deeply excavated.

Sloughing ulcer. *Sloughing ulcer* is more or less opaque, spreads rapidly, both in area and depth, and if the process be not soon arrested the cornea will be perforated, and a prolapse of the iris of greater or less extent (according

to the size of the perforation) will take place. If the opening be large the lens or some of the vitreous may escape.

In the greater number of cases of perforation of the cornea the iris pushes forward, fills the opening, and becomes adherent to its margins, forming an "anterior synechia," but a considerable prolapse may take place, forming a projection or bulge from the surface of the cornea—"staphyloma." Anterior synechia. Staphyloma.

Marginal or crescentic ulcer (ulcus corniæ serpens) is a somewhat peculiar form of corneal ulceration; it is met with in persons of middle age, is very intractable, and very liable to recur or relapse. This form of ulceration is accompanied by very severe pain, great intolerance of light, and very profuse lachrymation. On examination a crescentic patch of ulceration is found skirting generally the upper margin of the cornea; the ulcer is deep, its margin clean cut, and its surface glassy looking. Crescentic ulcer.

The ulceration spreads rapidly up to a certain point—remains stationary for a time, and then commences to heal slowly, the healing process being frequently interrupted by relapses.

The ulcerative process may involve both the upper and lower segments of the cornea, but never passes up to its centre.

Treatment.—The treatment of ulcers of the cornea is similar to that of corneitis, but in all cases it is better to keep the eye carefully bandaged. Iridectomy should be performed in any case should perforation be imminent (*see* p. 359). Treatment.

Opacities of the cornea are the result of inflammation, ulceration, or injury. Opacities of cornea.

They are met with of all densities and sizes; thin cloudy opacities are known as "nebulæ," dense white ones as "leucomata." A dense white opacity, involving the whole cornea, is called a "total leucoma;" an opacity of the same description occupying a part only, a "partial leucoma." Should a corneal opacity have been caused by a perforating ulcer or wound of the cornea, an "anterior synechia" will probably be found associated with it. Nebulæ. Leucoma.

False pterigium.—*Fleshy opacities* are sometimes met with near the margin of the cornea, and continuous with the conjunctiva. They are composed of granulation tissue, and are frequently the result of burns. False pterigium.

Treatment.—Corneal opacities have always a tendency to disappear, especially in children. Their removal may be aided by the use of slightly irritating applications, which set up a certain amount of increased vascularity, and thus aid absorption. The remedies generally employed are drops of sulphate of copper, iodide of potassium, or opium; turpentine, pure, or mixed in various proportions with olive oil; calomel powder, or the yellow oxide of mercury ointment. Any of these may be used for some considerable time. Should no improvement have taken place at the end of two or three months, and the opacity be so situated as to interfere with vision, an artificial pupil must be made, and if the opacity be disfiguring it should be tinted (*see* pp. 362, 358). The fleshy opacities may be removed by operation, but are very liable to reappear in their former site. Treatment.

Injuries.—Abrasions of the cornea may be caused by scratches from thorns, ends of straw, finger nails, &c. They give rise to severe pain, much intolerance of light, and watering of the eye.

Abrasions.

TREATMENT.—The eye should be kept carefully bandaged with lint soaked in belladonna lotion till the abrasion has healed.

Penetrating wounds.

Penetrating wounds of the cornea generally involve the iris or lens; in the former case an adhesion of the iris to the cornea (anterior synechia) is likely to be formed, or iritis set up; in the latter the lens will probably become opaque, a traumatic cataract being developed.

Very extensive wounds of the cornea may allow the escape of the lens or vitreous.

Treatment.

TREATMENT.—The eye should be kept carefully bound up with lint soaked in belladonna lotion, and in cases where the lens has been wounded, or iritis set up, a solution of atropine, one grain to one ounce of water, should be dropped into the eye from four to six or eight times daily.

Should the lens swell and cause pain and increase of tension, it must be removed without delay, or iridectomy must be performed.

Iridectomy may have to be performed at some future time for optical reasons, or to obviate the irritation caused by dragging on an anterior synechia. Traumatic cataract may also require to be treated.

Burns.

Burns of the cornea by lime, hot metals, &c., usually occur in conjunction with like injuries of the conjunctiva; they usually leave behind them opacities of greater or less extent and density, according to the severity of the injury, or may cause sloughing and destruction of the whole or greater part of the cornea.

TREATMENT, the same as that of burns of the conjunctiva.

THE SCLEROTIC AND EPISCLERAL TISSUE.

Episcleritis.

Inflammation of the sclerotic or episcleral tissue, or more commonly of both together, is a somewhat rare disease; it is characterised by the presence of purple swollen patches, covered by enlarged conjunctival vessels, and situated usually about the insertion of the recti muscles.

The purple patches often disappear from one portion of the globe, and appear again at another; the inflammation is chronic in its course, but subsides after a time, leaving some discoloration of the affected part; it is very liable to recur.

It occasionally follows operations for strabismus.

Treatment.

TREATMENT.—Sedative applications, as decoction of poppy-heads, or belladonna fomentation, should be used three or four times a day, and if there be much conjunctival vascularity or any mucous discharge some astringent lotion, as chloride of zinc drops (see Formulæ, p. 309) should also be employed.

Any constitutional treatment that may appear called for should be adopted. In some cases tonics do most good; others, again, may be greatly benefited by a course of mercury or iodide of potassium.

This disease is usually described as "episcleritis."

Staphyloma of sclerotic.

Staphyloma.—A bulge of the sclerotic may occur from softening of its structure by inflammatory changes, which usually commence in the choroid

Staphyloma may be met with in the ciliary region (ciliary staphyloma), about the equator (equatorial staphyloma), or near the optic nerve (posterior staphyloma). Little can be done in the way of treatment.

Injuries.—The sclerotic may be wounded by sharp instruments, or ruptured by blows; in the latter case the lesion usually takes place in the ciliary region, near the upper margin of the cornea. Wounds.

The sclerotic (as also the cornea) may be pierced by a shot or chip of metal, which may be lodged within the globe or have passed clean through it.

Treatment.—The treatment of injuries of the sclerotic depends much upon the extent and nature of the damage done. Treatment.

Small incised wounds will usually heal readily enough if the eye be kept carefully bandaged. Larger wounds may require to be closed by a suture.

Blows often cause complete disorganization of the globe, the aqueous and vitreous chambers being filled with blood, and hæmorrhage having taken place between the sclerotic and choroid, although no rupture of the external tunic has occurred.

Such cases must be carefully watched, and the eye kept bandaged with lint soaked in belladonna lotion.

In cases of extensive incised wounds, large ruptures, or wounds associated with lodgment of a foreign body within the globe, extirpation of the eyeball will probably have to be performed. (*See* p. 374.)

THE CRYSTALLINE LENS.

Congenital anomalies.—Variations in shape, absence of the whole (Aphakia) or part of the lens, and displacements, are met with as congenital defects. Congenital anomalies of lens.

Presbyopia (old sight).—Presbyopia depends on senile change of the crystalline lens, by which it is rendered harder than in youth and its elasticity is impaired. As a consequence its curvature can only be altered to a limited extent by the action of the ciliary muscle, and the power or range of accommodation is correspondingly diminished. Presbyopia.

Persons generally begin to experience the effects of presbyopia about the age of forty-five. The nearest point of distinct vision, which year by year has been receding from the eyes, now becomes inconveniently far off, so that small print can only be read with difficulty or not at all; distant vision, however, still remains acute. Age when it commences.

It has been arbitrarily decided that a person shall be considered presbyopic as soon as his nearest point of distinct vision comes to stand at twenty-two centimètres or further from the eyes, and the degree of presbyopia is expressed by the number of dioptrics (D) which it is necessary to give the eye in order to bring its near point up to this distance; or, in other words, to give it a refractive power equal to 4·5 D, which is the power of the lens which the crystalline must add to itself in order to see distinctly at twenty-two centimètres. Thus, a person aged forty-five can only see distinctly at twenty-eight centimètres, that is, he can only add to his crystalline a lens equal to 3·5 D. In order to enable him to see distinctly at twenty-two centimètres we must give a lens which makes up the difference between 3·5 D and 4·5 D, *i.e.* 1 D. A person of forty-five, therefore, requires a convex lens of 1 D to remedy his presbyopia; the number of this lens also expresses the degree of presbyopia. Its degree.

It has been determined by observation that presbyopia increases by

one dioptric for every period of 5 years from 40 to 60; sometimes by one dioptric and sometimes by a half only, for each similar period from 60 to 80.

Lens required.

The following table shows the lens required at each period of five years by the emmetropic eye. Should hypermetropia exist its degree must be ascertained and added to the number given in the table. The degree of myopia, on the contrary, must be subtracted:

Age.	Dioptrics.	Age.	Dioptrics.
40	0	65	4·5
45	1	70	5·5
50	2	75	6
55	3	80	7
60	4		

Should our patient require to see at some particular distance, the numbers in the table need not be adhered to; he may be allowed to select those lenses which he thinks suit best. As a matter of fact we often find that the glasses given in the table are too strong, especially in hypermetropic persons who have become presbyopic before taking to glasses. Such persons have long been accustomed to strain their accommodation to the utmost, and will not thank us for giving them glasses which neutralize the whole of their hypermetropia as well as their presbyopia. We shall give much greater satisfaction by ordering glasses which a little more than neutralize the hypermetropia, and so give a little help without being an absolute correction.

Traumatic cataract.

Injuries.—Opacity of the lens (traumatic cataract) may be caused either by penetrating wounds of the cornea or simply by concussion.

Dislocation of the lens.—As the result of blows upon the eyeball, the lens may become partially or entirely displaced; it may still retain its transparency, but often becomes more or less opaque.

Direction of displacement of lens.

Displacement of the lens may take place upwards or downwards, laterally, forwards into the anterior chamber, backwards into the vitreous, or it may be entirely extruded from the globe through a wound in the sclerotic, and lie beneath the conjunctiva. In the three first positions the displacement is only partial and the margin of the lens can be seen by oblique illumination occupying some part of the pupil.

In displacement forwards the pupil will be found dilated, irregular in shape, and fixed; oblique illumination will show the lens lying partially or entirely in the anterior chamber.

In displacement backwards the iris will be tremulous, the pupil sluggish, and the anterior chamber deepened. Direct ophthalmoscopic examination will probably detect the lens lying in the ciliary region at the lower part of the eye.

In displacement beneath the conjunctiva the lens is found forming a small rounded tumour, somewhere near the corneal margin, most frequently at its upper part.

Treatment.

Treatment.—If the lens be displaced partially or into the anterior chamber, and still retain its transparency, it may be left alone. But should it become opaque or appear to be setting up irritation, it should be removed by extraction, preferably associated with iridectomy. A transparent lens may remain for years in the anterior chamber, and, with the exception of impairment of vision, give rise to no inconvenience.

If its capsule has been lacerated, however, it will become opaque, and if not extracted will gradually be removed by absorption.

A lens displaced into the vitreous chamber will very probably act as a foreign body, and set up glaucomatous changes, in which case it should be removed at all risks; but if it produces no irritation is best left alone.

A lens displaced beneath the conjunctiva may also be left to itself.

Cataract will be considered in the section on operations.

THE IRIS AND CHOROID.

Coloboma.

Congenital anomalies.—**Coloboma** signifies a cleft condition of the iris or choroid, dependent on failure of closure of the fœtal fissure. In the iris it occurs as a deficiency of the lower segment, appearing as if iridectomy had been performed downwards. In the choroid it is seen (on examination with the ophthalmoscope) as a brilliant white figure, commencing at the optic disc, and continuing downwards and forwards for a variable distance towards the ciliary processes, through which, in extreme cases, the cleft may extend, and be even continuous with a similar deficiency of the iris.

The albino.

In the **Albino** the pigment of the iris and choroid is absent to a greater or less extent, and with the ophthalmoscope the fundus of the eye appears of a yellowish-white colour.

Irideremia.

Irideremia, or congenital absence of the iris, is occasionally observed.

Persistence of pupillary membrane.

Persistence of the pupillary membrane.—Small portions of the membrane which at a period of fœtal life covered the pupil occasionally remain, and may be seen as one or more fine threads, somewhat resembling cobwebs, passing across the pupillary area, and attached at either end to the anterior surface of the iris, near the margin of the pupil.

Anomalies of colour.

Anomalies of colour.—The iris of one eye may be brown, that of its fellow being blue, or differences in colour may occur in different parts of the same iris.

Tremulous iris.

Tremulous iris (iridodonesis) signifies a tremulous condition of the iris, which shakes about as the eye is moved. This condition is met with when the iris has lost the support of the crystalline lens, when the vitreous humour is abnormally fluid, or the iris totally paralysed.

Paralysis of iris.

The term *paralysis* should, strictly speaking, be applied only to cases where the iris is tremulous, all its proper movements being destroyed and the pupil of moderate size; but it is often used in the condition of dilatation of the pupil met with in some cases of paralysis of the third nerve; in which, however, only the circular fibres are affected.

Mydriasis signifies abnormal dilatation of the pupil; **Myosis**, abnormal contraction.

Tumours of iris.

Tumours seldom originate in the iris itself, but its structure often becomes implicated by growths commencing in deeper parts of the globe (*see* Tumours of Eyeball); instances, however, of malignant growths, dermoid and simple cysts, and of the cysticercus, have been met with in the iris.

Inflammation of the Iris (Iritis).

Causes.

Causes.

Local.—Irritation from foreign bodies in the conjunctival sac or cornea; friction of the cornea by granular lids or inverted lashes; inju-

ries to the iris itself by operations, or accidents, with or without the lodgment of foreign bodies in its substance or on its surface; pressure by a swollen crystalline lens, and exposure from perforation of the cornea.

Constitutional.—Debility, after acute disease, over-lactation, &c.; certain specific diseases, as syphilis, rheumatism, and gout.

Symptoms.

Symptoms.—The following symptoms are met with in most cases of iritis; changes of colour, cloudiness and loss of polish of the iris, sluggishness or complete immobility and (as a rule) contraction of the pupil, injection of the ciliary region (ciliary redness), watering of the eye, and impairment of vision. Other symptoms met with occasionally are pain, intolerance of light, irregularity in outline of the pupil, inflammatory products—pus or lymph nodules—visible to the naked eye.

Varieties of iritis.

Three varieties of iritis are commonly met with. 1. Simple iritis. 2. Recurrent or rheumatic iritis. 3. Syphilitic iritis.

Simple iritis.

Simple iritis.—All the more constant symptoms of iritis are present, often accompanied by more or less severe pain. An uncomplicated attack lasts from one to two weeks or longer, and usually ends in resolution, the iris quite recovering its normal condition, but a few adhesions may form between the iris and lens-capsule (posterior synechiæ). In this as well as in the other forms of iritis, however, the inflammation may run on to the formation of a considerable quantity of new material or into suppuration.

Recurrent iritis.

Recurrent or rheumatic iritis occurs in persons who are subject to attacks of rheumatism or gout, and also in the children of rheumatic or gouty parents; an attack of this form of inflammation presents all the more constant symptoms of iritis, and has one character peculiar to itself, viz. its tendency to recur, some patients having had as many as twenty or more separate attacks; in some cases the attacks observe a remarkable periodicity, recurring regularly at the same time of year. The inflammation sometimes appears in one eye, sometimes in the other, or perhaps in both, rarely, however, simultaneously, but at short intervals, the second eye becoming affected long before the first has begun to recover. Recurrent iritis is frequently accompanied by more or less haziness of the cornea and aqueous humour. In some cases very severe pain of a dull aching character is experienced in the eyeball, forehead, side of nose, and temple; in others the attack is most insidious, the patient's attention not being attracted until a considerable amount of new material has been thrown out, extensive adhesions formed, the sight of one eye much impaired and the inflammatory action extended to the other. The great feature of this form of iritis is its tendency to recur. The cause of the recurrencies is not very evident; they are probably due primarily to "posterior synechiæ," and are prevented by the performance of iridectomy.

Haziness of cornea.

All persons, however, who have "posterior synechiæ" are not subject to recurrent iritis; so that in all probability in those who are liable to repeated attacks there is a tendency to the lighting up of inflammation upon very slight provocation, such as the dragging of posterior synechiæ.

Syphilitic iritis.

Syphilitic iritis is, perhaps, the most common of all the forms.

A typical case presents all the constant symptoms of iritis in a very marked degree, the zone of ciliary redness being extremely well de-

fined. There may be, besides, certain peculiar nodular excrescences, of a dirty yellow colour (known as lymph-nodules), situated on the surface of the iris or at its pupillary margin, and at times extending into the pupil, which may be completely blocked by them. These excrescences are syphilitic gummata, and their existence renders the diagnosis of syphilitic iritis certain; they are, however, only occasionally present, and in the greater number of cases met with the surgeon will have to take into consideration the patient's previous history, ascertain the existence of other signs of syphilis, and make his diagnosis accordingly. Lymph-nodules.

Syphilitic iritis occurs most frequently between the ages of fifteen and forty, but is occasionally met with as a manifestation of congenital syphilis in infants.

Results of iritis.—In many cases, especially if early and properly treated, perfect recovery takes place; in others permanent signs of inflammation are left. The morbid changes more commonly met with are— Results of iritis.

(1) The iris itself may be found *atrophied*, *rigid*, or *rotten*, and very prone to bleed freely on the slightest wound. These conditions become most apparent when operating upon its structure. On attempting to perform iridectomy considerable difficulty will be experienced in removing a portion of the iris, which may be so tough that none of it can be torn away, or so rotten that only the portion included between the branches of the forceps is removed, or hæmorrhage may take place to such an extent as to prevent the completion of the operation. Atrophy of iris, &c.

(2) *Adhesions to neighbouring parts* ("*synechiæ*") may have formed, those most commonly met with being between the iris and lens-capsule ("posterior synechiæ"). Posterior synechia.

Posterior synechiæ are generally situated at the pupillary margin, and vary in extent from a few adherent tags, of this part only, to complete adhesion of the whole posterior surface of the iris to the lens-capsule, this latter condition being known as "total posterior synechia." Total posterior synechia.

Adhesion of the iris to the cornea, "anterior synechia" (should this occur at all as the result of iritis) will be found about its greater circumference. Anterior synechia.

(3) *Closure of the pupil* by inflammatory material, *opacities upon the lens-capsule* caused by adhesion of the "uvea" detached from the posterior surface of the iris. Closed pupil.

(4) Dense inflammatory deposits in or beneath the capsule, or involving the superficial fibres of the lens itself (*capsular cataract*), may also be met with. Capsular cataract.

Treatment.—In treating iritis we must take care, *first*, to remove any local cause, such as a foreign body, opaque swollen lens, &c., and to cure granular lids, or remove inverted lashes. *Secondly*, we must endeavour to dilate the pupil. *Thirdly*, to relieve pain. *Fourthly*, any constitutional treatment that may appear called for should be employed. (The means of carrying out the first indication are detailed elsewhere.) Treatment.

In order to dilate the pupil a few drops of a strong solution (gr. iv to ℥j) of sulphate of atropine should be placed between the eyelids by the surgeon himself at each visit, and a weaker solution (gr. ¼ to gr. 1 Local.

to ℥j) should be used by the patient from four to eight or twelve times a day. If the case is treated at the commencement, more or less dilatation of the pupil will usually take place; but should the iris have become infiltrated with inflammatory matter, and adhesions formed, little or no effect will be produced; the atropine should, however, be persevered with.

Iritis with suppuration.

In cases of iritis with suppuration the eye should be fomented frequently with hot belladonna lotion, and kept bound up with lint soaked in the lotion.

In cases accompanied by much pain blood should be taken from the temples by leeches or the artificial leech. Atropine may give rise to pain by causing dragging upon adhesions, and should be used with caution in cases where its application is attended by much suffering, especially if it have no effect upon the pupil. The eyes should be protected from light by a green shade or protectors until the inflammation has subsided.

Constitutional.

Of *constitutional remedies* there is none so useful in the treatment of iritis *as mercury*. The drug should be given in some form or other, so as speedily to affect the system in all cases where inflammatory products are plentifully produced, whether the inflammation be of

Mercury.

syphilitic origin or not. A pill containing gr. ij of Pil. Hydrarg. and gr. ¼ of Pulv. Opii may be taken three times a day, and is a very convenient and effectual mode of administration. Mercurial inunction, or vapour baths, may be employed if preferred.

Tonics.

If the iritis occur in debilitated states of the system, or the inflammation go on to suppuration, tonics, as iron or quinine, should be prescribed, and a plentiful supply of good food given. Should there be much pain opium must be given, and it is well to prescribe the drug in conjunction with extract of belladonna or hyoseyamus.

The results of iritis, should they seriously interfere with vision, require the performance of irideetomy or some one of the operations for artificial pupil. Irideetomy should also be performed in cases of recurrent iritis. The removal of a portion of iris in some manner—probably by preventing dragging on adhesions—has a marvellous effect in preventing recurrences.

Injuries.

Injuries.—The iris may be cut, torn, or bruised; prolapsed through, or adherent to, the cornea, in cases of penetrating wounds of that structure (*see* Wounds of the Cornea); or it may be separated from its insertion to a greater or less extent by concussion, without external wound. Any of these injuries are liable to set up iritis, which may possibly be followed by suppuration.

Treatment.

Treatment.—The injured eye should be kept carefully bandaged with lint soaked in belladonna lotion, and if much pain is complained of, or inflammatory symptoms arise, blood should be freely taken from the corresponding temple, either by leeches or the artificial leech.

As in iritis from other causes, the pupil may become blocked, or extensive synechiæ form, requiring operative interference at some later period. (*See* Operations on iris.)

Hyperæmia of choroid.

Hyperæmia of choroid.

Increased vascularity of the choroid is not unfrequently met with, more especially in myopic persons; it should be suspected if a feeling

of fulness and tension of the eyes, accompanied by watering and intolerance of light, is complained of.

On examination with the ophthalmoscope increased redness of the choroid (especially of that portion nearest the outer side of the optic disc) and some enlargement of the choroidal vessels can be made out; these changes will, however, very probably be overlooked by an inexperienced observer.

Treatment. Treatment.—The eyes should be kept carefully at rest, protected from light, cold douches employed, and all positions (as stooping or hanging the head) which cause congestion of the eyeballs carefully avoided; blood may be taken from the temples, and if glasses have been worn their use must be discontinued.

Choroiditis. **Inflammation of the choroid, "Choroiditis,"** occurs under much the same conditions as iritis; it also plays a prominent part in sympathetic ophthalmia, and is not unfrequently associated with inflammation of the iris—"choroido-iritis." Two forms will be commonly met with—simple and syphilitic.

Choroido-iritis. *Symptoms.*—In all cases of choroiditis more or less loss of transparency will be found. Pain, intolerance of light, impairment of vision, fulness of the veins emerging from the sclerotic in the ciliary region, ciliary redness, dilatation and sluggishness of the pupil, and increased tension of the globe, are symptoms often met with in choroiditis, but are by no means characteristic of it. A diagnosis can only be made with certainty by examination with the ophthalmoscope.

The changes seen in the choroid with the ophthalmoscope are, greyish or yellowish patches or spots of exudation surrounded by more or less redness (hyperæmia), and at a later period patches of atrophy. The exudation may occur in one or more large patches, or be distributed over the whole or greater part of the choroid in the form of spots, this latter condition being known as "choroiditis disseminata." We know that the morbid changes noticed are in the choroid, from their relation to the retinal vessels which pass in front of and are not obscured by the opacity.

Choroiditis disseminata.

Syphilitic choroiditis. **Syphilitic choroiditis** (in typical cases) is characterised by yellowish lymph-nodules similar to those met with in syphilitic iritis in the choroid; but, as in the latter disease, typical cases are only occasionally met with, and we must be guided by the same rules in forming a diagnosis. Choroiditis disseminata is syphilitic; the atrophic changes left by it are seen in spots of white and dark dotted about the fundus; often combined with an irregular band of dirty white extending round the optic disc. These changes are frequently seen in the subjects of congenital syphilis, the choroidal disease is in many instances associated with floating opacities in the vitreous, and may be looked upon as a certain indication of syphilis.

Choroiditis is frequently associated with inflammation and opacity of the vitreous humour; the retina covering the affected portion of choroid is usually involved in the inflammatory change, and the optic disc may be implicated if choroiditis exist in its vicinity.

Atrophy of choroid. **Atrophy of the choroid,** as above stated, frequently follows inflammation. The ophthalmoscope shows white or dirty white patches, or spots corresponding to the areas previously occupied by inflammatory exudation, caused by destruction of the choroid, allowing the white sclerotic to show more or less plainly through it. The atrophic

patches are frequently surrounded by dark borders, from accumulation of pigment which has been displaced by the inflammatory material.

Cyclitis. **Inflammation of the ciliary** portion of the choroid (ciliary body) is known as "cyclitis."

Cyclitis is characterised by redness and swelling of some part or the whole of the ciliary region, with considerable enlargement of the veins of the retina, choroid, and iris, and pain in the eyeball, aggravated by pressure in the ciliary region. Cyclitis may be caused by injury or may depend upon syphilis, inherited or acquired. Softening and shrinking of the globe is very likely to follow from impairment of nutrition, dependent on interference with the circulation of blood. Suppuration may also take place. Wounds implicating the ciliary region of the sclerotic should always be looked upon as much more serious than those of other portions of the tunic, as cyclitis is frequently set up by such injuries. Cyclitis is not uncommonly associated with iritis—"irido-clycitis."

Irido-cyclitis.

Treatment. TREATMENT.—The treatment of choroiditis should be very similar to that of iritis. Iridectomy does good in some chronic cases or in those in which there is increase of tension of the globe. For the atrophic changes no treatment is of much avail.

Deposit of bone. **Bone upon the choroid.**—Deposits of bone are not unfrequently met with upon the inner surface of the choroid in eyes that have been blind, and shrunken, for years.

Tubercle. **Tubercles in the choroid.**—In cases of general tuberculosis deposits of tubercle have occasionally been met with in the choroid.

Injuries of choroid. **Injuries.**—The choroid may be injured by foreign bodies entering the eyeball or ruptured by violence, without perforation of the tunics.

In the former case (more especially if a foreign body be lodged in the structure of the choroid) inflammation is very liable to follow, the eyeball being eventually lost by suppuration or shrinking. A rupture of the choroid from external violence is attended with more or less hæmorrhage, which fills the rent made in its structure with blood, and may cause considerable displacement of the retina.

Appearance of rupture. Seen with the ophthalmoscope soon after the receipt of the injury, a rupture of the choroid appears as a more or less elongated blood clot; later the blood becomes absorbed and a white linear figure is left, from the white sclerotic showing through the rent in the choroid. This form of injury is not often followed by destructive inflammation.

Treatment. TREATMENT.—Injuries of the choroid should be treated in the same manner as injuries of the sclerotic, cornea, or iris, with belladonna lotion, lint and a bandage.

Sympathetic Ophthalmia.

Sympathetic ophthalmia. Sympathetic ophthalmia is the name applied to a peculiar form of inflammation of the choroid, ciliary body, and iris, coming on in one eye in consequence of morbid changes which have previously existed or are still in operation in the other.

Danger of wounds of ciliary region. The most common causes of sympathetic ophthalmia are injuries of one eye, *especially wounds implicating the ciliary region*, or associated with *lodgment* of a foreign body in the interior of the globe.

The wounded eye shortly after the receipt of an injury may become affected by choroido-iritis, the inflammation being of a *markedly adhe-*

sive character; pain more or less severe will be complained of, sight rapidly lost, extensive synechiæ form, the tension of the globe, at first somewhat above par, diminish, and shrinkiug of the eyeball follow. Character of inflammation.

At any time during the foregoing changes in the injured eye the sound one may become irritable and painful, and a similar inflammation may be set up in it, leading rapidly to a like result.

Treatment.—Where sympathetic ophthalmia has been once established, in all probability irreparable damage will be done; the great point to bear in mind is to prevent its occurrence by *timely extirpation of the damaged globe* (*see* Extirpatiou of the Eyeball). Should the disease have become fairly established, little benefit can be expected to result from such extirpation, as the morbid changes will probably continue in the sympathetically inflamed globe, iu spite of the removal of that primarily affected. The sympathetically affected eyeball (or if excision have not been performed both eyes) should be kept carefully bandaged with lint soaked in belladonna lotion; pain must be relieved by the same methods as in cases of iritis. Any constitutional treatment that may appear necessary should be employed, and as soon as the more acute inflammatory symptoms have subsided iridectomy should be performed. This operation often exerts a very beneficial influence upon the nutrition of the globe (*see* Iridectomy), and should be repeated a second or even third time should the new pupil become (as is very likely to be the case) occluded by inflammatory exudations. Treatment.

Should suppurative inflammation be set up in one eye, sympathetic changes need not be feared in the other; it is only in the adhesive form of choroido-iritis that sympathetic ophthalmia is likely to occur.

THE VITREOUS HUMOUR.

Opacities in the vitreous are frequently met with in cases of myopia, and often as the results of choroiditis. Opacity of vitreous.

Inflammatiou of the vitreous occurs occasionally; it is generally of syphilitic origin or caused by injuries, especially the lodgment of foreign bodies withiu the globe. Vision becomes misty, and on examination the humour is found to be more or less turbid. Inflammation.

Treatment.—Should the inflammation be of syphilitic origin, antisyphilitic remedies should be employed; should it depend on injury, the eye must be kept bandaged with lint soaked in belladonna lotion, and measures taken to subdue the inflammation.

Hæmorrhage into the vitreous.—Occasionally bleeding takes place into the vitreous humour to a considerable extent. Impairment of vision is complained of, usually coming on suddenly, and often during some exertion. Examination with the ophthalmoscope (direct method) shows the vitreous chamber to be occupied by a turbid irregular cloud which floats about as the eyeball is moved, gradually subsides to its lower part when the movements are discontinued, and is stirred up again on the movements of the globe being repeated. The blood becomes absorbed to a greater or less extent in the course of time, but very commonly some permaneut opacity is left. Hæmorrhage.

Iridectomy appears to hasten the process of absorption.

GLAUCOMA.

By glaucoma we understand "A series of morbid changes of the eyeball; the most prominent of which, and apparently the one which causes all the others, being an increase of tension of the globe." (Bader.)

The cause of the increase of tension is unknown, but is supposed to result from undue accumulation of the intra-ocular fluids, dependent on hyper-secretion or deficient removal. Glaucoma is said to be *simple* when the increase of tension progresses slowly and continuously without inflammatory outbreaks; *acute or chronic* when attended by attacks of inflammation.

Simple glaucoma.

Simple glaucoma presents no very marked symptoms, its onset being most insidious. It is characterised by gradual decrease of acuteness of vision, with narrowing of the visual field, impairment of the power of accommodation, causing rather rapid increase of presbyopia, sluggishness in the movements of the iris, some dilatation of the pupil, and some apparent haziness of the lens. Increase of tension is probably one of the earliest symptoms, but is very liable to be overlooked until the disease is far advanced and considerable hardness of the globe has taken place. With the ophthalmoscope spontaneous pulsation of the retinal arteries may be seen, or pulsation may be produced by very slight pressure upon the globe. The vessels, especially the veins, are thinner on the surface of the optic disc than in the surrounding retina, and the disc itself more or less cupped. The cup of glaucoma is characterised by a bluish appearance of the greater portion of the disc; upon this blue portion the vessels appear very small and indistinct, or they may be quite invisible; the margin of the disc is white, and the large tortuous retinal vessels are seen curling up over its edge, and appearing on the surface of the retina at a point not continuous with their course upon the nerve surface. Small hæmorrhages may also be met with upon the retina.

Increase of tension.

Spontaneous pulsation.

Cupping of disc.

Absolute glaucoma.

Sooner or later, in any form of glaucoma, if relief be not given, the condition known as *absolute glaucoma* is established. The eyeball becomes stony hard, the pupil widely dilated and fixed, the cornea hazy and anæsthetic, the iris and aqueous humour discoloured, the anterior chamber shallow, and the lens more or less opaque. A few dilated veins are seen issuing from the globe in the ciliary region, the sclerotic may be somewhat bulged in places and bluish in colour, and the conjunctiva is extremely rotten, tearing on any attempt to seize it with forceps. On examination with the ophthalmoscope all appears dark behind the pupil, or a dull red reflection may be returned from the interior, but no details of the fundus can be made out. All perception of light is lost.

Premonitory symptoms.

In some cases of acute glaucoma, and almost invariably in chronic glaucoma, the onset of the disease is preceded by premonitory symptoms.

These are, as in simple glaucoma, rapidly increasing presbyopia and slight increase of tension of the globe, sluggishness and dilatation of the pupil, some apparent haziness of the lens, and narrowing of the visual field.

Besides these we may find some congestion of the veins emerging from the sclerotic in the ciliary region. There may be periodic attacks

of dimness of vision, objects appearing as if veiled by a greyish or yellow mist (London fog); in the later stages we may have a halo aronnd a flame, or the appearance of a raiubow, and at times attacks of pain in and ahont the eyeball.

Acute glaucoma usually commences snddenly with well-marked inflammatory symptoms. The patient will state that he was seized (frequently during the night) with sndden severe pain in the eye; the pain will he described as affecting, not only the eyehall, but the whole of the corresponding side of the head, and he will have found that the sight of the painful eye is much impaired or entirely lost. On examination the eyelids will he fonnd slightly reddened and swollen, the conjunctiva somewhat chemosed, and its vessels, as well as those situated more deeply in the subconjunctival tissue, enlarged. There will be profuse lachrymation, and often much intolerance of light; the aqueous hnmour will very probably he somewhat tnrhid. The pupil will be dilated, somewhat irregular and fixed, and the tension of the globe greatly increased. Acute glaucoma.

On examination with the ophthalmoscope some of the appearances mentioned under simple glaucoma may he found, but the media will probably be so hazy as to obscure the parts behind, a dull-red reflection being all that can he made out. Ophthalmoscopic appearances.

The acute symptoms may pass off in the course of a few days or weeks, leaving the eye more or less permanently damaged. Similar attacks may recur, hut more frequently the disease relapses into a chronic state.

Chronic glaucoma, the form most commonly met with, is characterised hy the occurrence of slight inflammatory attacks, associated with temporary increase of dimness of vision and more or less pain in and around the eyeball. On examination the field of vision will be found to be limited, the tension of the globe increased, and if the patient present himself during an inflammatory attack the conjunctiva and subconjunctival tissue will he found unduly vascular, the pupil somewhat dilated, and the movements of the iris sluggish. Chronic glaucoma.

The loss of vision, in cases of chronic glaucoma, is attended by somewhat peculiar symptoms. Patients complain that their sight is always somewhat misty, that there is an appearance of a bright halo around a candle or other flame, that they see colours resembling a rainbow, and often of great beauty, and occasionally flashes of light and fiery circles; these latter symptoms are, however, common to all forms of retinal irritation. Vision is always worst during the inflammatory attacks and recovers to a certain extent during the remission, never, however, returning to the same condition as before the attack. Peculiar affection of vision.

The ophthalmoscope shows changes similar to those mentioned under simple glaucoma.

There is yet another form of glaucoma requiring mention, fortunately rarely met with. Its principal characteristic is the extreme suddenness and violence of its onset; its symptoms resemble those of acute glaucoma in an aggravated form. This variety of glaucoma is known as *glaucoma fulminans*, and the eye attacked hy it may be entirely lost in the course of a few hours. The attack is occasionally accompanied by severe headache and vomiting. Glaucoma fulminans.

Glaucoma is essentially a disease of commencing old age, occurring

most frequently between the ages of fifty and sixty, but occasionally in young adults, or even in children. Glaucoma almost always affects both eyes, not, however, simultaneously, but at more or less considerable intervals.

Diagnosis of glaucoma.

In order to diagnose glaucoma we must be well acquainted with the method of ascertaining the tension of the globe, and also with the use of the ophthalmoscope. (*See* Examination of eyeball, &c.)

We must also remember that the injurious effects of pressure are evidenced earliest in the peripheral portions of the retina, and should therefore very carefully examine the condition of the *visual field* in all suspected cases. (*See* Examination of field of vision.)

Contraction of visual field.

Cases are frequently met with in which great contraction of the visual field has taken place, although central vision is still acute.

Rapid increase of presbyopia.

Another symptom which should lead us to suspect glaucoma is the *rapid increase of presbyopia.* Patients affected by the simple or chronic forms of the disease are constantly changing their glasses, as they find that those which at first appear to suit become useless in the course of a few months.

Apparent haziness of lens.

Apparent haziness of the crystalline lens is a symptom requiring special attention; otherwise the surgeon may fall into the fatal error of mistaking chronic or simple glaucoma for cataract, and allow the disease to continue until sight is irrevocably lost. In such cases ophthalmoscopic examination will most probably show that there is little or no real opacity of the lens, and this, aided by a careful examination of the tension of the globe and the state of the visual field, will prevent so disastrous a mistake.

Besides the foregoing we not unfrequently meet with what is known as "secondary glaucoma," *i.e.* glaucoma coming on in the course of some other disease, as corneitis, ulceration of cornea, iritis, &c. Glaucoma occurring in young persons is usually secondary.

Treatment.

TREATMENT.—Glaucoma can be remedied *by operation alone.* And it is our duty to explain to the patient the nature of his case and to urge upon him most strongly the *necessity* for operative interference.

Patients suffering from glaucoma often evince the greatest unwillingness to undergo an operation; this unwillingness is explained by the fact that during the *remissions* of the disease little or no inconvenience is experienced, and, moreover, even at the time that an attack of inflammation is present the sufferer will be encouraged by the hope that the symptoms will pass off (as they in all probability have done in previous attacks), leaving the eye but little damaged. Nevertheless we must always bear in mind *that an operation, to be successful, must be performed early,* and must not be satisfied until we have convinced our patient of this. Most patients will readily submit to an operation when one eye has been lost and the disease has commenced in the other.

Iridectomy.

Several operations have been practised for the relief of glaucoma, but iridectomy is that which gives the best results, and is almost universally practised at the present day. Iridectomy, to be effectual, should be performed as early as possible; as a rule, no good is likely to result from the operation in cases where vision has been reduced to bare perception of light; but in acute glaucoma much improvement

may take place even though all perception of light have been lost for some days.

In performing iridectomy for glaucoma we must take care to remove the iris well down to its insertion and to excise a good broad piece (*see* p. 364); merely cutting away a portion of the iris near the margin of the pupil does no good. The operation is easy enough of performance in cases of acute glaucoma, but in those of old standing the structures become so rotten as to render it anything but simple.

Medical treatment.

In cases of glaucoma where for any reason an operation does not seem advisable we must do our best to give relief by medical treatment. The means which will be found most useful are the application of sedative fomentations, administration of opium, and the local abstraction of blood by leeches or the artificial leech.

Atropine.

Atropine *should not be used* in glaucoma, as it causes increased vascularity of the globe, and with it augmentation of tension. Its application is recommended in most works on ophthalmic subjects, but it does more harm than good.

THE RETINA AND OPTIC NERVE.

Vision.

Vision.—Space will not allow of a detailed account of all the anomalies of vision which may be met with. Before the introduction of the ophthalmoscope all cases of *want of sight* occurring without cause apparent to the unaided eye were collected together into two classes bearing the names of "amblyopia and amaurosis."

Amblyopia and amaurosis.

To the former were referred all cases where vision was much impaired but not entirely lost, to the latter cases in which not even perception of light remained. But now that the ophthalmoscope has come so generally into use, making the interior of the globe as accessible to our sight as the exterior, we have come to refer "amblyopia and amaurosis" to their proper causes, and the terms have fallen into comparative disuse. For instance, if in a case of want of sight we find on ophthalmoscopic examination that there is haziness of the vitreous, inflammation of the retina, &c., we do not say (as formerly) that the patient is "amblyopic," but that he is suffering from opacity of the vitreous, retinitis, &c. Again, in cases of total blindness, the ophthalmoscope will in all probability detect atrophy of the optic nerve or other lesion, and instead of saying that the patient is "amaurotic" we say that he is suffering from atrophy of the optic nerve, &c. The terms "amblyopia and amaurosis" may, however, still be used in some rare cases where there is a partial or complete loss of sight, associated with an apparently healthy condition of all the ocular structures.

Hyperæmia of retina.

Hyperæmia of the retina occurs from overstrain of the eyes in doing near work (especially in hypermetropic or astigmatic persons), or from constantly looking at bright light; the disease is not uncommon amongst engine-drivers and others who work over a blazing fire.

The patient complains of some dimness of vision, and a feeling of fulness and discomfort in the eyes. On examination with the ophthalmoscope the retinal vessels, both arteries and veins, will be found increased in size, and a greater number of each will be visible than in the healthy retina.

Active and passive hyperæmia.

This form of hyperæmia may be described as "active;" another

form of hyperæmia, affecting only the retinal veins, which become enlarged, tortuous, and sometimes varicose, may be described as "passive;" this condition is indicative of obstruction to the return of blood from the eyeball. (*See* Ischæmia.)

Hyperæmia of the retina, especially the active form, is not easily recognised, as the limits between health and disease fade almost imperceptibly into each other, and considerable experience is required in order to judge with certainty where one ends and the other begins.

Treatment. TREATMENT.—Active hyperæmia should be treated by rest, carefully shielding the eyes from bright light by means of blue protectors or a shade. After the subsidence of the hyperæmia any anomaly of refraction should be carefully neutralized.

Retinitis. Passive hyperæmia is usually an indication of some more serious disease, and requires no special treatment.

Inflammation of the retina (retinitis).—*Causes.*—Retinitis most frequently depends on some constitutional condition, as albuminuria or syphilis; it may also arise from embolism of the vessels of the retina, hæmorrhage into its substance, or from cerebral disease; from tumours or entozoa within the globe, exposure to sudden flashes of bright light, or wounds of the eyeball. It may also be secondary to choroiditis, iritis, or eyelitis.

Retinitis is characterised by hyperæmia of the retina, associated with more or less dense and extensive opacity of its structure, and frequently with extravasations of blood in its substance.

Affection of vision. Disturbance of vision may be a prominent symptom, or the patient may hardly be aware that anything is amiss with his eyes. The degree of impairment of vision depends upon the situation and extent of the inflamed portion of the retina; for instance, a small patch of inflammatory exudation in the region of the yellow spot will cause much loss of sight, whereas a considerable amount of opacity situated peripherally will give rise to scarcely any symptoms.

Pain, photophobia, coloured vision, and flashes of light, are symptoms occasionally met with in inflammation of the retina.

Acute retinitis is rarely met with, and if it should occur would hardly be recognised, as the inflammatory exudation would be transparent, and, therefore, invisible; consequently the only appearance revealed by the ophthalmoscope would be enlargement and tortuosity of the retinal vessels.

The forms of retinitis which give rise to striking ophthalmoscopic appearances are essentially of a chronic nature, and are frequently associated with inflammatory changes in the choroid and optic nerve.

Retinitis may affect one or both eyes, those forms which are of constitutional origin usually affecting both, though not always in the same degree. Several varieties of retinitis are described.

Simple retinitis. Simple retinitis.—The ophthalmoscope shows a more or less general turbidity of the retina, varying from a scarcely perceptible cloudiness (giving the idea that the structure is coloured and visible instead of entirely transparent) to an uniform greyish-white or mottled opacity, which appears to cover the choroid like a veil.

The outline of the optic disc is indistinct. The retinal veins appear enlarged, dark coloured, evidently gorged with blood, often twisted

in their course, and they may be in parts hidden by the inflammatory exudation. The condition of the arteries is nearly normal, or they may appear too thin.

Small hæmorrhages are frequently detected in the course of the distended veins.

Hæmorrhagic retinitis.

Hæmorrhagic retinitis.—The optic nerve will be found reddened, somewhat swollen, its outline obliterated, its transparency so much affected that the course of the retinal veins upon its surface and in its substance cannot be traced; the retinal veins are turgid, and tortuous in their course, presenting alternately light and dark portions, according as they lie deeply in the engorged retina or more superficially near its inner surface. The retinal arteries, as in the simple form of retinitis, are nearly normal or too thin.

Peculiarity of blood extravasations.

The principal characteristic of the disease is the occurrence of extensive hæmorrhage, most marked around the optic disc, and fading away gradually into the surrounding parts. The blood-extravasations have a peculiar striated appearance, and radiate, spoke-like, from the optic disc as a centre. In some cases the retina immediately surrounding the disc is uniformly soaked with blood, the bright red colour thus produced gradually shading off externally into the spoke-like appearance above mentioned.

As time goes on the extravasated blood undergoes changes, becoming brown in colour, and eventually partially or entirely absorbed.

Retinitis pigmentosa.

Retinitis pigmentosa is a peculiar form of degeneration of the retina, met with most frequently in the offspring of blood relations; the sufferers are often deaf and dumb, and may be partially idiotic.

Night blindness.

The most marked symptoms of the disease are *night blindness* and *gradual narrowing of the visual field without glaucomatous symptoms.* The ophthalmoscope reveals the most striking changes; the retina, more especially about its peripheral parts, is dotted more or less thickly with black pigment spots; these spots appear somewhat like a multitude of small black spiders with many legs; they have also been likened to bone-corpuscles. The spots of pigment appear to follow the course of the blood-vessels of the retina, and, as before stated, are collected most thickly in its peripheral parts.

The blood-vessels themselves are much diminished in size and visible number, and the optic disc is markedly anæmic.

Albuminuric retinitis.

Albuminuric retinitis is a peculiar form of retinitis met with in Bright's disease. The changes which take place in the retina are inflammation with effusion and hæmorrhages, followed by fatty and fibrinous degeneration of its structure, and subsequent atrophy.

The ophthalmoscope shows, in the early stages of the disease, retinal hyperæmia (more especially venous) with increased vascularity and redness of the optic disc. Next the retina becomes cloudy (more especially around the optic disc, the outline of which becomes obscured), and numerous hæmorrhages in the form of streaks and spots occur in various parts of its structure.

Characteristic appearances.

The cloudiness goes on increasing and obscures the smaller vessels; later in different parts of the fundus, but mostly in a ring situated at a little distance from the margin of the disc, appear glistening white spots and patches, which by their coalescence eventually form a broad white band, which partially or entirely surrounds the now grey opaque

optic disc, being separated from it by a grey opaque portion of retina. These appearances are entirely characteristic of albuminuric retiuitis.

Changes in yellow spot.

Whilst the above changes are going on in other parts of the retina, characteristic appearances may be developed iu the region of the yellow spot. A number of small white glistening spots, which, however, do not coalesce so as to form a band, but remain distinct, make their appearance. These glistening spots are arranged in a somewhat radiated position around the macula as a centre, and somewhat resemble a constellation; the appearance is quite characteristic, and once seen is not likely to be forgotten.

As the opacity of the retiua increases, the vessels become more and more obscured, so that when the disease has reached its height only a few large venous trunks are still visible. Fresh hæmorrhages may occur at any time, and cover over and obscure the opaque portions of retina. After a time a retrograde process sets in, the hæmorrhages and peculiar opacity slowly disappear, the retina being at length left in a state of atrophy. Displacement of the retina may occur.

Alhumiuuric retinitis is usually associated with granular kidney; it is depeudeut on the blood-vascular disease (arterio-capillary-fibrosis, Gull and Sutton), of which the kidney affection is only a part. The retinitis often appears before any sign of kidney mischief is mauifested, and it is the ophthalmic surgeon who first discovers the nature of the case.

Leucæmic retinitis.

Leucæmic retinitis.—A peculiar form of retinitis somewhat resembling the albuminuric has been described as occurring in connection with leucocythæmia.

Leucæmic retinitis is marked by pallor of the optic disc, a peculiar rose colour of the retiual vessels, hæmorrhages, some opacity of the retina around the optic disc, and white glistening spots similar to those met with in albuminuric retinitis, which, however, are situated in the peripheral parts of the retina.

Embolism of retina.

Embolism of the retina.—A form of retinitis associated with plugging of the central artery comes ou suddenly without apparent cause, with complete loss of sight. Ophthalmoscopic examination shows some pallor of the optic disc and dimiuution in calibre of the vessels emerging from it, but the most marked change is seen in the regiou of the yellow spot.

Changes about yellow spot.

The retina around the spot is grey and opaque, and numerous blood-vessels not visible under ordinary conditions come plainly into view; the macula itself is seen as a bright red spot (which might be taken for a hæmorrhage by a careless observer) situated in the centre of the opaque portion of retina.

The bright red appearance of the macula arises from the auatomical arrangement of the parts; the retina in this situation, being thin aud firmly bound down to the parts beneath, does not become infiltrated with iuflammatory exudatiou, and consequeutly the normal red colour of the fundus appears in striking contrast to the surrounding opaque retina. Hæmorrhages may occur.

Syphilitic retinitis.

Syphilitic retinitis.—A form of inflammation affecting the retina immediately surrounding the optic disc has been looked upon by some as of syphilitic origin, but, like syphilitic iritis, rarely presents auy very characteristic signs. Should retinitis occur with other manifes-

tations of syphilis, congenital or acquired, it may be looked upon as syphilitic.

Treatment of retinitis.

Treatment.—Both eyes should be kept thoroughly at rest, by prohibiting all near work, paralysing the accommodation by atropine, and shielding the eyes from the stimulus of too bright light by blue protectors. Everything that is likely to cause disturbance of the ocular circulation, as stooping positions, excitement, stimulants, too rapid variations of temperature, &c., should be carefully avoided.

Abstraction of blood. Mercury.

In simple retinitis blood should be taken from the temples by leeches, or preferably by the artificial leech, and in this form as well as in retinitis connected with syphilis mercury does good; it should be given so as quickly to affect the system either by the mouth, by inunction, or in the form of vapour baths. In cases of long standing, however, small doses of the bichloride of mercury, taken regularly for some months, may be beneficial. The other forms of retinitis are of only secondary importance to the disease with which they are associated, and against which treatment must be directed (*see* Causes of Retinitis). No treatment is of much avail in retinitis pigmentosa.

Atrophy of retina.

Atrophy of the retina may be the sequel of inflammatory changes. Its principal characteristic seen with the ophthalmoscope is a condition of bloodlessness, in some cases associated with opacity of the retina and frequently with atrophic changes in the choroid. Bloodlessness shows itself in a diminution of the visible number and also of the calibre of the retinal blood-vessels, more especially of the arteries, some of which may appear pervious to red blood-corpuscles in part of their course, only their continuations being marked by a yellowish-white cord. Opacities, if they occur, are of a greyish-white colour, and situated for the most part around the optic disc.

Condition of optic disc.

The disc itself is frequently extremely anæmic or atrophied. (For treatment of atrophy of the retina, *see* Atrophy of the optic disc.)

Hæmorrhage into the retina.

Hæmorrhage into the retina.—Besides the form of hæmorrhage described as occurring in retinitis, bleeding may take place into the structure of the retina, from rupture of a retinal blood-vessel without previous inflammatory change. The hæmorrhage is usually considerable, and will be seen as an irregular patch of blood, situated somewhere in the course of the ruptured vessel, and often surrounded by inflammatory exudation.

The extravasated blood becomes gradually absorbed, but usually leaves behind it some indications of its previous existence.

Treatment.—Rest of the eyes and protection from bright light.

Displacement of retina.

Displacement of the retina is associated with effusion of serous fluid between it and the choroid; it may be caused by blows on the eyeball or the head in its vicinity; it may occur without apparent cause, and is often met with in myopic eyes. Displacement of the retina occurs by preference at its lower part, but may vary in extent from detachment of a small fold to total separation of the whole retina from the choroid, the only points of attachment left being at the optic disc and ciliary processes.

The ophthalmoscope shows a grey, opaque, movable cloud, over the surface of which the retinal blood-vessels can be traced.

Treatment. TREATMENT.—Little can be done to remedy displacement of the retina, but an attempt should be made to procure absorption of the fluid by the administration of such drugs as iodide of potassium and mercury, and by the application of blisters to the temple. If the displacement occur in connection with myopia the anomaly of refraction should be carefully neutralized by suitable glasses, and in all cases rest should be insured to the eyes, so as to prevent as much as possible further detachment.

Optic neuritis. **Inflammation of the optic disc (optic neuritis, neuro-retinitis)** occurs as the result of irritation of the trunk of the nerve in some part of its course external to the eyeball, the inflammatory change extending downwards along the nerve and finally affecting its intra-ocular portion, hence it is sometimes described as "descending neuritis." The ophthalmoscope shows a reddish-grey turbidity of the disc and the surrounding zone of retina, accompanied by swelling of the parts. The retinal veins are engorged, but their visible number is not increased; the arteries are thinner than usual, and all the vessels are more or less shrouded and concealed from view in the opaque portion of retina and upon the nerve surface. Numerous small hæmorrhages may occur upon the disc and around it.

Vision is always considerably affected in *optic neuritis*.

Choked disc. **Ischæmia of the disc (choked disc).**—Choking of the optic disc is met with in a large majority of cases of cerebral tumour or other affections within the cranium which cause obstruction to the return of venous blood from the eyeball. It is frequently confounded with optic neuritis, from which, however, it differs in some essential particulars. In choked disc the intra-ocular portion of the nerve alone is affected. The ophthalmoscope shows great swelling and an intense red colour of the disc, its outline being entirely lost; there is, however, but slight swelling or opacity of the surrounding retina; small hæmorrhages are frequently seen on the nerve surface. The retinal veins are enormously distended, their course extremely tortuous, and they may be varicose; their visible number is also considerably increased. The arteries are thinner than natural or of normal calibre; none of the vessels are shrouded and concealed from view, as in neuritis. In by far the greater number of cases of ischæmia of the disc vision is unaffected. Ischæmia may go on to neuritis.

Generally speaking, optic neuritis commencing as such may be looked upon as indicative of irritation of the nerves in some part of their course.

Ischæmia means simply obstruction to the venous circulation, and may result from pressure directly on the main trunks, or from any form of disease whatever which causes *over-crowding* of the contents of the cranium. Both neuritis and ischæmia are usually bilateral.

Treatment. TREATMENT.—Optic neuritis and ischæmia of the disc are of only secondary importance to the disease which gives rise to them; they are of much greater interest to the physician than to the oculist, as their existence enables him to diagnose cerebral lesion with great certainty.

Atrophy of optic nerves. **Atrophy of the optic nerve** is usually the result of preceding neuritis, when it is called "consecutive atrophy," but occasionally cases are met with where the atrophy seems to have commenced as such, and

to have slowly progressed without inflammatory change, "simple atrophy."

With the ophthalmoscope the optic disc will be seen to be white or bluish white in colour, frequently its margin appears irregular, and it may be cupped. The atrophic cup varies from the glaucomatous in not having steep sides, so that the vessels do not appear broken in their course as in the latter affection; it does not take in the whole nerve, but only its central part, which slopes gradually backwards; the vessels appear curved on the surface of the disc, but are not altered in calibre as in glaucoma. Atrophy of the retina frequently goes along with atrophy of the optic disc. Atrophic cup.

In cases of atrophy of the optic nerves vision is always much impaired; some patients with extremely white discs can count fingers or even distinguish large letters, but in the majority of cases vision is reduced to bare perception of light. State of vision.

TREATMENT.—The treatment of atrophy of the optic nerves, especially if associated with a similar condition of the retina, is most unsatisfactory, and, indeed, almost hopeless. Should a certain amount of vision still remain, and no change have taken place for many months, we may safely assure our patient that he will retain what sight he has. The drugs which have been principally used are iron, either alone or in combination with nux vomica, strychnia taken by the mouth or injected hypodermically, phosphorus, quinine, or other tonics, and opium in gradually increasing doses. Galvanism has also been employed. Treatment.

OPERATIONS ON THE EYEBALL AND ITS APPENDAGES.

POSITION OF THE PATIENT AND OPERATOR, &c.

ALL the minor operations, such as slitting the canaliculi, passing probes down the nasal duct, opening tarsal cysts, &c., can best be performed when the patient is seated in a chair, and the operator stands behind him; the patient's head, over which a towel has first been thrown, resting against the operator's chest. (*See* Fig. 93.) Operations.

The more important operations, as extraction of cataract, iridectomy, squint, &c., should be performed whilst the patient is lying on a hard couch, his head resting on a bolster covered by a towel, which should be thrown forward over the forehead; the operator should sit or stand behind (*see* Fig. 94). In whichever position an operation is to be performed, the chair or table should be placed in front of a large window so as to insure a good light, and care be taken to prevent assistants and others from interposing their heads or bodies between the patient's face and the source of light. It will be found whilst operating that, with the exception of occasional pronation and supination, there is little occasion to use the arms, which should be kept with the elbows near

the sides, the wrists resting on the patient's head or face, in a position which allows of free movements of the hands and fingers.

Position of patient and operator.

Fig. 93.



Position for minor operations. (Sitting.)

Fig. 94.



Position for major operations. (Lying.)

Every ophthalmic surgeon should learn to use his fingers, cultivate his sense of touch, and, if possible, become ambidextrous.

Incisions.

It will be found that incisions can be best made by holding the knife lightly between the thumb and first two fingers of whichever hand is most conveniently situated.

In all operations incisions commencing at or situated entirely on the outer aspect of the globe should be made with the hand corresponding to that side, the opposite hand being employed upon the inner side. That is to say, if the right eye is operated on, the right hand should be used to make an incision at its outer side, the left at its inner, and *vice versâ*.

Incisions above or below may be made with either hand; scissors should also be used with whichever hand is most favorably situated.

In one operation, that for internal strabismus, the positions of patient and operator are somewhat different from those already described, the operator standing in front, at the side of the couch on the patient's right, instead of behind his head.

The scissors may be used with the right hand for both eyes, but in operating on the left the hands will have to be crossed.

Condition of instruments.

Before performing any operation the operator should look carefully to the condition of the instruments he is about to use. Knives should be passed through a piece of thin leather tightly stretched on a small metal cylinder, and care taken to ascertain that they have good points and that there are no notches in the blades.

Scissors should be carefully examined and tried; it should be seen that forceps close perfectly and are free from rust or dirt; silk for sutures should be black, as fine and strong as possible, well waxed, and

free from flaws or kinks. Inattention to these details may very possibly mar the success of an operation.

Use of anæsthetics.

Administration of anæsthetics.—The operator will find that he has much more command over the eye when the patient is under the influence of an anæsthetic than when consciousness remains, and in by far the greater number of cases he will do well to administer one.

Occasionally patients are met with who will bear operations most quietly; such should be operated on without anæsthesia; but if during the operation the patient become unsteady, or begin to strain, it is best not to risk failure, but to discontinue the operation and administer an anæsthetic. If the globe has been opened, it must be carefully guarded by a pad and bandage during the administration. If no anæsthetic be employed the operation should be performed as simply and quickly as possible; no speculum should be used, nor should the eye be fixed with forceps, but the operator should keep the lids open, and steady the globe with the fingers.

After-treatment.

AFTER-TREATMENT.—Operations on the tear passages, removal of tarsal cysts and strabismus, require little or no after-treatment; the parts need only to be washed twice or three times a day with tepid water.

After more severe operations on the eyelids, and in all cases where an incision has been made into the globe, the eye should be carefully covered with two small folds of lint, wetted with cold water, and secured by a single turn of bandage; the lint being kept wet and the eye bound up until the incision has healed and all irritation subsided. Wounds of the globe made in operations, as a rule, heal rapidly, union having frequently taken place at the end of twelve hours.

The great danger after operations on the globe is the occurrence of inflammation.

Occurrence of inflammation.

Inflammation, once set up, may subside shortly, leaving no trace behind it; it may continue until more or less irreparable damage has been done, or may run on to suppuration of portions or the whole of the globe; the cornea is more liable to this change than any other structure.

Time of onset.

The symptoms of inflammation usually appear within the two days immediately succeeding an operation, and little fear need be entertained for the safety of the eyeball if all has gone well for a week.

Occasionally, after cataract extraction, eyes have been lost through inflammation, or suppuration commencing at a later period, but these cases are rare, and probably it will be found that some damage has been done to the eye shortly before the symptoms appeared.

Treatment of inflammation.

The treatment of inflammatory changes consists in the local abstraction of blood from the temple by leeches, or the application of the artificial leech; the use of fomentations of water, poppy-heads, or belladonna constantly applied; the administration of opium in full doses, either alone or combined with mercury. The treatment must, of course, be varied according to the condition of the patient; should he be weakly and anæmic, we should be careful about bloodletting, and instead quinine and iron, with good living and a fair amount of stimulants, should be prescribed.

The local abstraction of blood, however, acts most beneficially in relieving pain, and should therefore be employed in cases where pain

is a prominent symptom, even though the patient does not appear to have much blood to lose. Strong healthy patients should be leeched freely, and kept on light diet.

During the treatment the eye must be kept carefully closed and bandaged, excepting during the time that fomentations are being applied. Moderate pressure by carefully applied pads of lint and cotton wool, secured by a few turns of flannel bandage, is said to exert considerable influence in cases where the cornea is threatened by suppuration; it should have a fair trial, if pressure can be borne.

Pressure.

If the inflammation go on to suppuration of the whole globe the case must be treated in the same manner as abscess in any other part. (*See* Ophthalmitis.)

Insertion of seton.

Insertion of a seton in the temple.—In order to place a seton in the temple, the position of patient and operator should be as in Fig. 93, p. 340. The operator should pinch up the skin with the finger and thumb of one hand, just in front of the patient's ear, and pass a seton needle armed with a double thread of stout silk through the fold thus produced; the silk should be drawn through and tied in a short loop. The seton should pass for about $1\frac{1}{2}$ in. beneath the skin, and should be placed amongst the hair, so as to avoid as much as possible disfigurement from the subsequent cicatrix; the silk should be drawn backwards and forwards through the wound every morning; it may be left in as long as appears necessary.

Wound of temporal artery.

Care must be taken in passing the needle not to wound the temporal artery; should this accident happen the seton must be removed and firm pressure applied with a pad and bandage.

Artificial leech.

Application of the artificial leech.—This instrument consists of a small sharp steel cylinder (worked by a spring arrangement), with which a circular incision can be made through the skin of the temple, and a hollow glass cylinder, which can be placed over the wound, and the air in its interior exhausted by means of a piston worked by a screw; as the air is removed the blood flows up to fill the vacuum. Care must be taken not to work the screw too quickly, but only to move the piston at the same rate as the blood flows; neither must the edge of the cylinder be allowed to compress the skin against the parts beneath, otherwise the flow of blood will be impeded.

THE EYELIDS.

Tumours.—Various small growths are met with about the eyelids.

Molluscum.

Molluscum occurs as a small yellowish-white projection, having a depressed and often blackened centre, situated on some part of the skin of the lids; there may be only one or many of these little growths. They can be easily removed by thrusting a knife through them, and then squeezing out the contents with the thumb nails.

Congenital sebaceous cyst.

Dermoid cysts are not unfrequently met with situated deeply beneath the skin and muscle, often near the outer angle of the orbit. They are congenital, filled with sebaceous matter, and often contain hair. They must be carefully dissected out, much more trouble being experienced in so doing than would be at first suspected, and they will in all probability be opened during removal. These little tumours will be found attached deeply to the periosteum, and may have caused a depression in the bone.

Warts are not unfrequently met with about the eyelids; they should be cut off with scissors. Warts.

Tarsal cyst is met with as a dusky red or colourless projection from the outer surface of the lid; its position is marked on the conjunctival surface by a bluish spot, from which a granulation is occasionally seen growing. The cyst is formed by obstruction of a Meibomian gland and retention of its secretion; it is sometimes in a suppurating condition. Tarsal cyst.

The lid should be everted, the cyst freely opened from the conjunctival surface with a small knife, and its contents squeezed or scooped out; it must be thoroughly emptied, or it will, in all probability, re-form. Treatment.

The cavity left on removal of the contents of the cyst will always fill with blood, and shortly after the operation the tumour will be as large or larger than before; the patient must be warned of this. Filling of cavity with blood.

The swelling will most probably disappear in the course of from four to six weeks; if it remain longer the operation should be repeated.

A tarsal cyst sometimes degenerates into a hard fibrous little mass, feeling somewhat like a large shot beneath the skin, which is known as a *chalazion;* this should be dissected out through an incision in the skin of the lid, which should afterwards be closed by a fine suture. Chalazion. Treatment.

Xanthelasma is often met with as a small yellow patch on some part of the skin of the eyelids; its most frequent site is the surface of the upper lid near the inner canthus. The little patch may be excised if it is a source of anxiety to the patient. Xanthelasma.

Simple serous cysts occur about the margins of the lids; they are about the size of small peas, and nearly transparent. A portion of the cyst wall should be cut out with scissors. Simple cyst.

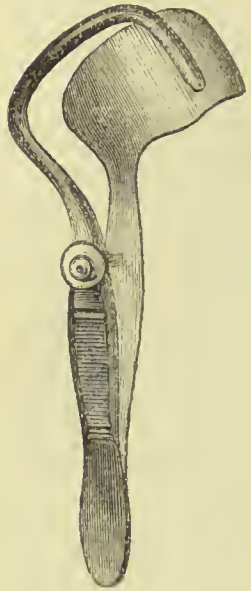
Trichiasis signifies a faulty direction of the eyelashes, which turn inwards and irritate the cornea; it is usually caused by contraction of the conjunctiva (following granular ophthalmia or its unskilful treatment), producing displacement of the hair *follicles*. Trichiasis.

Only a few lashes may be misdirected, or the whole row may be inverted. If only a few of the lashes turn inwards, it is sufficient to pull them out with forceps whenever they become troublesome. If a considerable number or the whole row are inverted, their roots should be removed by operation. The operation should be performed as follows:—The patient being placed in the usual position (*see* Fig. 94, p. 340), the lid should be secured by a compressorium forceps (Figs. 95, 96), by which means it is steadied and hæmorrhage prevented, care must be taken not to screw the instrument up too tightly, or sloughing of the lid may follow. The lid being well secured, the operator should make an incision through the skin, about three lines from the free margin of the lid and parallel with it, of such a length as to correspond to the lashes which are misplaced; the incision should be carried down to the outer surface of the tarsal cartilage; a second incision should then be made of the same length as the first, in the margin of the lid, and so conducted as to split the lid and separate the skin and hair-bulbs from the subjacent structures; the ends of the two incisions should then be joined by two short cuts, and the portion of skin included with the hair-bulbs dissected off the tarsal Treatment. Operation.

cartilage. The raw surface should then be wiped with a sponge, and any black dots denoting the presence of hair-bulbs carefully removed.

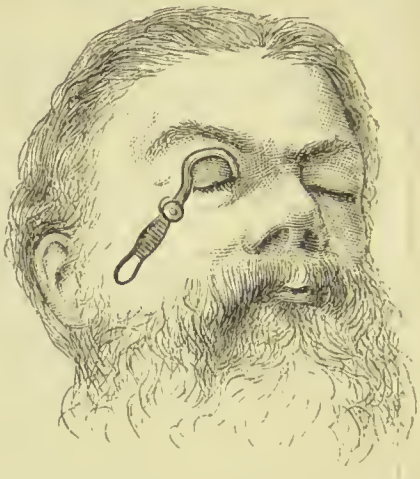
Fig. 95.

Compressorium forceps.



Compressorium forceps.

Fig. 96.



Compressorium forceps applied.

The compressorium forceps should then be unscrewed, when sharpish hæmorrhage will take place. The eye must be covered by two pieces of wet lint secured by a turn of bandage.

Entropion.

Entropion signifies a rolling inwards of the whole lid, the whole row of lashes being completely turned towards the eyeball; it is most frequently met with in the lower lid, more especially in old people with a superabundance of loose skin about the face. It is often the cause of much trouble and annoyance, as well as of danger to the eye after cataract extraction.

The inversion may be caused either by spasmodic contraction of the orbicularis muscle or by distortion and thickening of the tarsal cartilage after granular ophthalmia.

From spasmodic contraction of orbicularis.

Entropion caused by contraction of the orbicularis is easily remedied as follows:—The patient, lying on a couch (*see* Fig. 94, p. 340), the operator should seize with forceps the skin of the lid at a point near one or other canthus, about two lines from its margin, and then with scissors remove a portion in breadth corresponding to about half the surface of the lid, and extending along its whole length; he should then seize and remove the orbicularis muscle to a corresponding extent; no suture need be used; the eye should be bound up with wet lint and a bandage. The subsequent healing of the wound and contraction of the cicatrix will remedy the inversion.

From distortion of tarsal cartilage.

Entropion depending on distortion and thickening of the tarsal cartilage is usually met with in the upper lid. It can be remedied by removal of a wedge-shaped piece of cartilage, including the more

thickened portion, by the following operation :—The patient, being in the usual position (*see* Fig. 94, p. 340), and the lid fixed by a compressorium forceps, an incision should be carried through its whole thickness, parallel with and about two lines distant from its margin, along the whole extent of the thickened portion, with a sharp knife. A somewhat lunated incision should then be made from one end of the first around the base of the thickened portion of tarsus joining the first incision at its other extremity; the second incision should not be carried vertically through the cartilage, but obliquely, so as to meet the first at the conjunctival surface; the portion of cartilage included between these incisions should then be removed, the wound closed by sutures, and the eye bound up with lint and a bandage. The skin and muscle covering the cartilage may be removed or not, according to the fancy of the surgeon. If their removal is not desired, they should be dissected back before making the second incision. After the operation the margin of the lid should appear rightly directed. Removal of portion of tarsal cartilage.

Ectropion signifies an everted condition of the lid; the extent of eversion varies in different cases, from slight falling away of the margin of the lid from the globe to eversion of the whole extent of the lid and adjoining fornix of the conjunctiva. Ectropion.

The slighter forms are caused by distension of the lid from inflammatory swelling, and are easily remedied by slightly narrowing the palpebral aperture, by paring the edges of the lids near the outer canthus, and bringing the raw surfaces together by a suture, when firm union will take place between the two. From distension.

The more extreme forms are caused by the contraction of cicatrices of burns, wounds, or inflammatory changes, about the orbit. From contraction of cicatrices.

No definite rules can be laid down with regard to the treatment of these cases. The surgeon must be guided by the conditions as they present themselves, and do the best he can.

In any case, if the tarsal cartilage be left entire, it should be carefully dissected away from its attachments and replaced as nearly as possible in its normal position, in which it must be kept by paring its margin and that of the opposite lid, and securing extensive and firm union between them by careful coaptation of their raw surfaces. The lids must not be opened until all further contraction of the original cicatrix is at an end, and it is better to leave the eye closed for considerably too long a period than to open it a day too soon. Ectropion is also frequently seen in the more severe forms of ophthalmia or in cases of severe intolerance of light, and is specially liable to occur when an attempt is made to open a firmly closed eye. In these cases the eversion requires no special treatment, but disappears as the affection causing it is recovered from. From photophobia.

Formation of a new eyelid.—In some cases of burn, or from ulceration of a lupoid character, more or less complete destruction of the eyelids may take place. To remedy this defect, a flap of skin from a neighbouring part may be brought, placed in the gap, and there secured by means of sutures, care being always taken that the piece of skin is considerably larger than the surface it is intended to cover. Before removing any skin, search must be made in any portion of the eyelid that may be left for the tarsal cartilage, and if this be found it must be carefully dissected out and preserved, its natural form being as much as possible restored; it should be fixed in its proper position by Formation of new lid. Preservation of tarsal cartilage.

uniting its margin to that of the opposite lid. Even if no flap of skin be applied over it, it will in time become covered with cuticle, and form a very effectual covering to the eyeball.

Symblepharon.

Symblepharon signifies adhesion of the conjunctiva of the eyelid to that of the globe. It is usually caused by burns with lime or hot metal, and may occur to any extent, varying from a thin band of union to fusion of the greater part or whole of both lids with the globe.

Bands of adhesion.

This condition requires to be remedied by operation. Where only a thin band of adhesion exists it should be first carefully secured by a suture passed through the extremity nearest the eyeball, and then be divided, and drawn into the fornix by passing the suture through the lid and securing it to a small roll of strapping, placed upon the cutaneous surface. By this means the raw surface left by removal of the band from the globe is brought into contact with healthy conjunctiva and granulates over, healing without forming adhesions.

If more than one band exist, each should be dealt with separately.

Extensive adhesion.

Cases of more extensive adhesion give rise to the utmost difficulty in treatment, and until lately the operations performed for their relief were attended with only indifferent success. One plan of treatment recommended was to dissect away the adhesion and interpose a shell of glass between the raw surfaces, but as healing invariably commenced at a point remote from the free margin of the lid, the shell was gradually pushed out and the adhesion re-established.

The insertion of pieces of wire deeply beneath the adhesion, which were left in until the walls of the canal made by them had healed, the remainder of the adhesion being then divided with scissors, was followed by no more satisfactory results.

Teale's operation.

Lately, an operation has been introduced by Mr. P. Teale, of Leeds, which has been attended with the best success. The operation has for its object the separation of the raw surfaces by a piece of conjunctiva, taken from some other part of the eyeball. The following is an extract from the account of the operation given by Mr. Teale in the transactions of the Fourth Ophthalmic Congress, 1872.

"The patient being under the influence of an anæsthetic, the eyelid is freed from its attachment to the lid; next, a band of somewhat circular form is marked out, with a sharp knife, upon the sound conjunctiva; the band commences at one end of the gap left by liberation of the lid and passes round the sound side of the cornea, terminating at the opposite extremity of the gap.

"Four stitches are then inserted, two on each edge of the flap thus formed. The flap is next separated on its *under surface*, whilst its extremities are left continuous with the conjunctiva; it is then drawn across the surface of the cornea, and fixed, raw surface downwards, into the gap formed by the liberation of the eyeball from the lid; it is secured in its new position by the sutures already alluded to, aided by as many others as may appear necessary."

Mr. Teale states that "the operation is most tedious," and that he rarely completes it within the hour.

Anchyloblepharon.

Anchyloblepharon signifies an adhesion of the lids to each other. The adhesions must be divided with scissors, and, if possible, some skin or conjunctiva interposed between the raw surfaces; but if this cannot be

done, reunion may be prevented by passing a probe between the lids daily.

Narrowing of the palpebral aperture (Blepharophymosis) is usually a result of granular ophthalmia, and is accompanied by entropion, displaced tear puncta, and consequent watering of the eye. It requires to be remedied by operation, which can be thus performed:—The lids being kept widely open and on the stretch by a wire speculum (Fig. 97), an incision should be made with strong scissors through the outer canthus. A flap of conjunctiva, of somewhat conical shape, should then be marked out on the surface of the eyeball, the flap freely dissected from the subjacent structures, but left attached at its base, which is towards the cornea, and then fixed by sutures in the incision made by the scissors, in such a manner as to keep the raw edges separated by a mucous surface. Blepharophymosis. Treatment.

Fig. 97.



Wire speculum.

It is sometimes necessary to narrow or close entirely the palpebral aperture. This operation, known as *tarsoraphy*, can be performed as follows:—The lid being held with forceps, a portion of *the inner edge* of its margin should be removed with a small iridectomy knife, care being taken not to cut away any of the outer edge containing the lashes, nor to wound the tear puncta or canaliculi. The opposite lid should then be treated in the same manner, and the raw edges brought together by sutures; firm union will soon take place between them. Tarsoraphy.

Ptosis signifies a drooping of the upper eyelid to a greater or less extent, with inability to raise it. Ptosis occurs with divergent strabismus and more or less impairment of the mobility of the eyeball, in cases of paralysis of the third nerve, and is generally, but not invariably, accompanied by dilatation and fixity of the pupil. Ptosis.

It is also met with as a congenital defect, and occurs sometimes after severe inflammation of the lid, or protracted intolerance of light, and constant spasmodic action of the orbicularis muscle. Women past the middle period of life, with a superabundance of loose skin about the face, are also subject to a form of partial ptosis.

Treatment.—In ptosis from paralysis of the third nerve treatment must be directed against the cause of the paralysis, no operation being advisable; other forms can be remedied by removal of some skin and orbicularis muscle from the surface of the lid. Treatment.

The operation may be performed as follows:—The skin just above the margin of the lid should be pinched up with forceps, the amount included between their blades being such as to raise the margin of the Operation for ptosis.

lid well above the upper border of the pupil. Then with seissors a strip of skin of the required width should be removed, along the whole extent of the lid, parallel to its margin; the orbicularis muscle should then be clearly dissected off the tarsal cartilage to about the same extent, the wound closed by one or two fine sutures, and the eye bound up with wet lint and a bandage.

The wound will heal in the course of a few days, and the shortening caused by the removal of the skin and muscle, and subsequent cicatrization (possibly aided by the entanglement of some fibres of the occipito-frontalis in the scar) should keep the lid in the desired position.

In cases of congenital ptosis we often find movement of the eyes upwards greatly impaired; it seems probable that the superior rectus is badly developed or altogether absent.

THE LACHRYMAL APPARATUS.

Lachrymal gland.

The lachrymal gland is occasionally the seat of malignant or other growths, and may require extirpation.

Cysts.

A cyst is sometimes met with caused by obstruction of one of the ducts of the gland and accumulation of secretion. The disease is known as *dacryops*.

Treatment.

Its treatment consists in establishing an opening into it from the surface of the conjunctiva; this is easily done by passing a curved needle armed with silk from beneath the upper lid through the wall of the cyst into its cavity, and out again at a convenient distance; the silk should then be drawn through, and the portion of cyst-wall included between the entrance and exit of the needle firmly ligatured; the ligature will slough out and leave a permanent opening, causing no inconvenience. If the cyst be opened through the skin it may leave a troublesome fistula.

Tear puncta and canaliculi.

The tear puncta and canaliculi.

The tear puncta in the normal condition lie in contact with the ocular conjunctiva; they may be either everted, as seen in old and neglected cases of tinea, or rolled somewhat inwards; they are sometimes found entirely obliterated, either by disease or injury, burns of the eyelids being the most common cause.

The canalicuii may also be found more or less obstructed in any part of their course. Any of these conditions are accompanied by troublesome watering of the eye, "epiphora." They can be remedied by slitting the tear puncta and canalicuii.

Lachrymal sac.

The lachrymal sac is often the seat of acute inflammation, which may arise in the sac itself, spread to it from the conjunctiva, or be caused by disease of the surrounding bones. It is characterised by

Inflammation.

a dusky red, tense swelling, situated at the side of the nose, close to the inner canthus, the swelling and redness often extending outwards along both the upper and lower lids; one or both sacs may be affected. The inflammation may end in resolution or go on to the formation

Abscess.

of an abscess; in the latter case, the swelling becomes soft and fluctuating.

Treatment.

TREATMENT.—At first, hot fomentations and poultices must be applied, and attention paid to the general health; if abscess form, the pus must be let out by a free incision. If an abscess of the lachrymal sac

be allowed to burst a fistulous opening will very probably be left, but if a free opening be made so soon as the formation of pus is suspected, the wound heals readily.

Distension of the lachrymal sac (Mucocele). Mucocele.

The lachrymal sac not unfrequently becomes distended, forming a tumour of varying size beneath the internal palpebral ligament (tendo oculi); pressure on the tumour causes the escape of a transparent, somewhat tenacious fluid, consisting of mucus and tears, in some cases thickened from the admixture of pus-cells. Distension of the sac is caused by stricture of the nasal duct and consequent accumulation of secretion; it is accompanied by more or less watering of the eye, and may be remedied by relieving the stricture of the duct.

Discharge from the lachrymal sac (Blennorrhœa). Blennorrhœa.

A muco-purulent or purulent discharge from the sac is often met with, following inflammation, especially if disease of the adjacent bone exist. It may be treated—1st. By insuring a free exit for the discharge by slitting the canaliculus, and passing a large probe down the lachrymal duct. 2nd. By washing out the sac. 3rd. By obliteration of the sac.

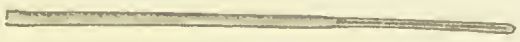
Stricture of the nasal duct may be met with in any part of its course; the obstruction, however, is most frequently found at its junction with the lachrymal sac. Occasionally the duct is found almost obliterated by dense bony deposit. Stricture of nasal duct.

Fistula of the lachrymal sac occurs as a small, sometimes scarcely perceptible opening, situated at some point over the sac; it is found in connection with obstruction of the nasal duct. If the passage be reestablished, the fistula will probably close. Fistula of lachrymal sac.

Operations on the tear passages.

The operation of slitting the tear puncta and canaliculi may be performed thus:—The patient should be seated in a chair, the operator standing behind him. (*See* Fig. 93, p. 340.) Supposing the lower punctum and canaliculus on the right side to be operated on, the small

Fig. 98.



Grooved director for slitting canaliculus.

and ring fingers of the left hand should be placed upon the patient's face, near the outer canthus, the lids drawn tight, with these two fingers, and kept so; then a small grooved director (Fig. 98) should be taken in the right hand and passed at first vertically to the margin of the lid, through the tear punctum; its handle then depressed, and its point passed horizontally along the canaliculus into the sac. To ascertain that the point of the director is in the sac, the tension of the lids must be relaxed and the director pushed gently onwards; if there be any puckering at the inner canthus when the director is thus pushed, its point has not entered the sac, and a further attempt must be made; if no puckering occur, the lids should be brought again into a state of tension, and the handle of the director transferred to the thumb and forefinger of the left hand; a cataract or any small knife that will cut, should then be taken in the right hand, and run along the groove of the director well into the sac, the knife and director being then withdrawn together; the upper lid must be kept out of the way by Slitting canaliculus.

one of the fingers of the right hand. The operation can be performed on the left side in the same manner, with the exception that the hands are reversed.

The upper punctum and canaliculus sometimes require to be slit; this operation is not quite so simple as that on the lower lid, but is performed in much the same way. In lieu of the grooved director and knife, a small probe-pointed canaliculus knife may be employed; it should be passed through the tear punctum and canaliculus in the same manner as the director, and will cut its way out as it goes.

After-treatment. The patient must be seen at intervals of two or three days for a week, or longer, after the operation, and a probe passed along the incision to prevent it closing.

Probing nasal duct.

Probing the nasal duct.

Bowman's probes. For the treatment of stricture of the nasal duct a set of silver probes (Bowman's) are used: there are three probes in a set, the two extremities of each being of different thicknesses, so that there are six sizes, No. 1 being the smallest, No. 6 the largest.

Passing probe. To pass a probe down the nasal duct, the canaliculus should be first slit, or, what is better, should have been slit at some previous time. The surgeon should stand behind the patient in the same position as for performing the last operation; and the lids being made tense in the same manner, the probe should be passed along the slit canaliculus until the point is well within the sac, as shown by the absence of puckering at the inner canthus or relaxation of the tension of the lids; the opposite extremity should then be raised along the margin of the orbit until the probe has attained a vertical direction, care being taken, while so doing, to keep the end which is in the sac pressed firmly against its inner side; the probe, having been brought into a nearly vertical position, should be pushed gently but firmly downwards and slightly backwards and outwards in the direction of the duct; when it has been passed as far as it will go it should be slightly withdrawn, so as to raise its end off the floor of the nose. If the probe has been properly passed down the duct its upper part will remain firmly in contact with the margin of the orbit; but if it moves freely about, the probe is not in the duct, but has been forced through its wall. This little accident is of no particular moment, and needs only that the probe be withdrawn and passed afresh in the right direction.

Accidents. If the end of the probe is not well within the sac before an attempt is made to pass it down the duct, it may slip backwards into the orbit, or forwards and downwards in the cellular tissue of the cheek. A probe having been satisfactorily passed, should be left in for about twenty minutes, and the operation be repeated about twice a week. The treatment of stricture of the lachrymal duct is, on the whole, unsatisfactory, but the probing should be carefully and perseveringly carried out. It is well always to commence with the largest probe, No. 6, and try a smaller one if this cannot be passed.

Washing out lachrymal sac.

Washing out the lachrymal sac.

For washing out the lachrymal sac a good syringe fitted with nozzles of different sizes is required. One of the nozzles should be fitted to the syringe, which has been previously filled with fluid (water, a weak solution of nitrate of silver, chloride of zinc, &c.), the nozzle should then be passed along the previously slit canaliculus into the sac and the fluid injected; the patient's head must be bent forwards during

the injection, or the fluid will run back along the floor of the nose into the pharynx.

Obliteration of the lachrymal sac. Obliteration of lachrymal sac.

In some cases of obstinate discharge from the sac, especially if dependent on diseased bone, the discharge may be stopped, and the patient made more comfortable by closing up the sac entirely; of course, more or less watering of the eye will remain after the operation, but is far to be preferred to the annoyance of a constant purulent discharge.

Obliteration of the sac may be attempted in any of the three following ways. A free incision having been made into it, and the blood carefully sponged out, its living membrane may be destroyed—(1) by filling its cavity with a thick paste of chloride of zinc and starch, in equal parts, enclosed in a small piece of lint; (2) by the application of nitrate of silver, or (3) by the galvanic or other cautery. By any of these procedures adhesive inflammation is set up, more or less obliteration of the sac following.

Operations for obliteration of the lachrymal sac are by no means always successful, and may have to be repeated, perhaps more than once, before a satisfactory result is obtained.

THE CONJUNCTIVA.

The conjunctiva.

But few operations are performed on the conjunctiva alone, it is, of course, cut in some of the operations on the eyelids and in that for strabismus, and some others.

Warts are occasionally found on some part of the membrane; they require to be removed with scissors. Warts.

Pterygium is a peculiar, somewhat triangular growth, the base of which is situated in the ocular conjunctiva generally near the inner canthus, the apex encroaching more or less upon the margin of the cornea, or passing for a considerable distance upon its surface. The growth is of a reddish colour and variable density; it consists of hypertrophied connective tissue. Pterygium.

Pterygium is not common in this country, and when met with is usually found to occur in sailors and others who have been in the east. If it give rise to any inconvenience or threaten to impair vision it must be removed by operation.

The patient should lie on the couch, the lids be opened by a wire speculum, the growth seized with toothed forceps and with a cataract knife dissected up from the surface of the cornea. A small portion of conjunctiva should then be removed parallel with the margin of the cornea, and the apex of the growth fixed by a suture in the wound. The eye should be kept bound up for a few days with wet lint and a bandage. Transplantation.

If a pterygium is simply cut off it will, in all probability, grow again, but if transplanted it will shrivel up, and disappear without giving further trouble. A cicatrix always remains upon the cornea after removal of pterygium, so that it must never be allowed to grow over the pupil.

Pinguiculæ are small yellowish growths situated beneath the conjunctiva, generally near the outer and inner margins of the cornea; they are surrounded by a few large blood-vessels, and are occasionally the source of constant irritation, causing the eyes to be bloodshot and Pinguicula.

uncomfortable. Pinguicula can be removed, if desired, by making an incision over it, turning back the conjunctiva, then seizing the little growth with forceps, and dissecting it away from the parts beneath. The growth having been removed, the conjunctiva should be closed over the wound by a suture, and the eye kept bandaged for two or three days after the operation.

Fatty tumour.

Lipoma is met with as a tumour projecting beneath the upper lid, near the fornix, and often between the superior and external recti muscles; it somewhat resembles a third lid. If the tumour gives any trouble it must be removed by operation, thus:—The patient lying on the couch, the lids should be kept as widely open as possible by a wire speculum, an incision made with a cataract knife through the conjunctiva over the tumour, and its most projecting portion seized with toothed forceps and removed with scissors; care must be taken not to drag upon the growth, as it is continuous with the fat in the cavity of the orbit, a great portion of which might be pulled out. As much of the tumour as is thought necessary having been removed, the conjunctiva should be closed over it with sutures, and the eye bound up.

Nævus.

Nævus occasionally occurs in the conjunctiva; it may be removed by the knife, or destroyed by the galvanic cautery, in the latter case due precautions must be taken to guard the eyeball from injury during the operation, and to prevent as much as possible the evils arising from subsequent cicatrisation.

Cancerous ulcers.

Cancerous ulcers may also be met with; they must be thoroughly extirpated, the eyeball being excised, if necessary.

Cysts.

Cysts containing a clear serous fluid are occasionally met with in the conjunctiva; they must be punctured, when they at once subside, but sometimes re-form, in which case a portion of the cyst-wall must be excised, or a fine seton passed through it.

Cysticercus.

Cysticercus also occurs, and should be treated by incision of the cyst.

EXTERNAL MUSCLES OF THE EYEBALL.

Strabismus.

Strabismus (squint).—"Strabismus is a deviation in direction of the axes of the two eyeballs, in consequence of which the two yellow spots receive images from different objects. In convergent strabismus the two visual lines do not cross each other at the point it is desired to observe; only one of the two, that of the undeviating eye, reaches it. Under this deviation not only does the expression of the face suffer from want of symmetry in its most eloquent parts, but the power of vision, at least in one of the eyes, is usually disturbed, and the squinter always loses the advantage of binocular vision." (Donders.)

Causes.

Strabismus must not be looked upon as a special form of disease; it is in by far the greater number of cases associated with some anomaly of refraction, which, being the primary cause of the deviation, gives rise to the strabismus; other conditions which may induce strabismus will be subsequently considered.

Varieties.

Two forms of squint are commonly met with. 1. Convergent. 2. Divergent. Other rare forms are superior and inferior strabismus; these will receive no further notice.

Convergent strabismus is the most common of all, and is almost always the result of hypermetropia.

Divergent strabismus is usually the result of myopia.

Convergent strabismus, as just stated, is nearly always the result of hypermetropia. The question naturally arises, How does hypermetropia produce it? Convergent strabismus.

The hypermetropic individual must always accommodate strongly when looking at even a distant object; and as the object is brought nearer, the tension of accommodation must be correspondingly increased. As stated at page 303, accommodation is associated with convergence of the visual lines. Now, the greater the degree of convergence the more strongly is the accommodation brought into play; consequently there is an ever increasing tendency on the part of the hypermetropic individual to converge too much, in order to bring his accommodation into the highest possible state of tension. If the convergence of the visual lines be excessive, or if they do not meet in the same point, convergent strabismus results. Connection with hypermetropia.

The question next arises, Why do not all hypermetropic individuals squint? The reason is that if both eyes are of the same refraction, and have equal acuteness of sight, there is always such a desire to maintain binocular vision that the visual lines will remain directed to the same point, even though the eyes are not accurately accommodated for that point, the individual being content with ill-defined retinal images rather than sacrifice binocular vision by increasing his convergence.

But if vision of one eye be less acute than that of the other, or if there be a difference of refraction between the two, the desire for binocular vision is lost, or its value very much lessened, and the necessity for a well-defined image on one retina is immediately felt. The accommodation is put fully on the stretch, and with it the degree of convergence becomes excessive, both visual lines being directed to points nearer to the eyes than that for which they are accommodated, the deviation of the more defective eye being greater than that of its fellow.

Treatment.—Slight cases of convergent strabismus, especially if the deviation is not constantly present, but only occasional (periodic squint), may be cured by the use of glasses which accurately neutralize the existing hypermetropia. Treatment. Periodic strabismus.

In more severe cases division of the internal rectus tendon in one or both eyes is necessary.

It is often difficult to decide whether only one or both eyes shall be operated on.

If it is found that one eye squints habitually and to no great extent, the other being always used for fixing an object, only deviating slightly when it is excluded, and an attempt made to fix with the habitually squinting eye, division of the internal rectus of that eye which habitually deviates alone is necessary.

If each eye deviates alternately (alternating strabismus), and to the same extent, division of one internal rectus may be sufficient; but if three weeks or a month after the operation the squint still continues, tenotomy of the internal rectus of the other eye should be performed. Alternating strabismus.

If one eye squints considerably and habitually, the other having an inclination to deviate at times, and if this deviation becomes excessive when the eye is excluded and an object fixed with the habitually squinting eye, the internal rectus in both eyes must be

divided. In any case, if there be a doubt as to whether one or both eyes should be operated on, it is well to be on the safe side, and do only one at a time.

Operation for convergent strabismus.

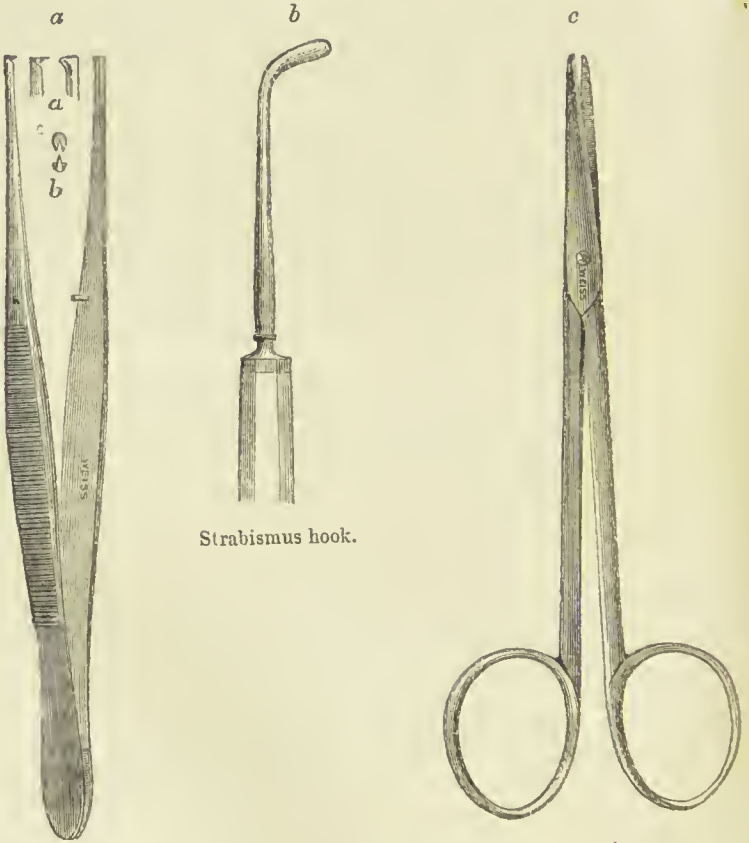
Operations for convergent strabismus.

There are two principal methods of operating for convergent strabismus.

1. The operator should stand on the right side of the patient, placed in the usual position (Fig. 94, p. 340), and the eyelids being kept well open with a wire speculum, should seize the conjunctiva and subconjunctival fascia with the toothed forceps (Fig. 99*a*) at a point about midway between the margin of the cornea and semilunar fold, and just below the inferior margin of the tendon of the internal rectus muscle. An incision should then be made with strabismus scissors (Fig. 99*c*) through the conjunctiva and subconjunctival fascia, well down to the sclerotic, and the strabismus hook (Fig. 99*b*) passed through the opening and inserted between the tendon and the eyeball. If properly intro-

FIG. 99.

Instruments for strabismus.



Strabismus hook.

Toothed forceps; *a*, their points shown in side view; *b*, front view.

Strabismus scissors.

duced the hook will be brought up short at the insertion of the tendon into the sclerotic when it is pulled forwards; it should be held firmly

in position, the scissors passed through the opening, one blade following the hook between the tendon and the eyeball, the other being kept outside the tendon, which is thus included between the two blades, and the tendon should then be divided by one or two sharp strokes with the scissors. Division of the tendon.

The scissors may now be withdrawn, and the hook pulled forwards; if the latter meets with no resistance, but passes freely up to the corneal margin, the operation has been successfully performed; to make sure of this, however, the hook should be withdrawn, the action for hooking the tendon repeated, and any fibres that may have escaped division cut through.

On the division of the tendon the muscle retracts, the retraction being limited by the subconjunctival fascia with which it is intimately connected. If the eye is not properly directed after simple division of the tendon, a greater effect may be produced by further freely severing the subconjunctival fascia. Connection with subconjunctival fascia.

2. In the second operation, the position of the patient and surgeon should be the same, and the lids be kept open with the wire speculum, as in the one already described.

An incision should be made with scissors through conjunctiva and subconjunctival fascia, over the insertion of the tendon, instead of below its inferior margin; the tendon then picked up with the strabismus hook, and divided close to the sclerotic. The wound in the conjunctiva should be afterwards closed with a fine suture.

No after-treatment is required for strabismus operations; the patient may go about as usual and simply keep the eyes clean. But if, when the eyes have quite recovered from the effects of the operation, there should be any return of the squint manifested, the degree of hypermetropia must be carefully ascertained, and glasses which thoroughly neutralize it ordered to be used for all purposes. In most cases this will be found sufficient; but if after the glasses have been perseveringly worn for some weeks no effect is produced the operation should be repeated in one or both eyes.

Use of anæsthetics in operations for convergent strabismus. Use of anæsthetics.

Whether anæsthetics should be employed or not in squint operations appears to be a matter of opinion; some eminent oculists never employing them, others again rarely operating without. For my own part, I prefer not to employ an anæsthetic if the patient is pretty steady, but with children and nervous adults I always use one, taking care, however, that a full effect is not produced, and if there is any doubt as to whether one or both eyes are to be operated on I allow the patient to come nearly to after finishing one eye, so as to ascertain the effect produced by what has been done; if an anæsthetic is given to such an extent as to exert its fullest influence, and produce thorough muscular relaxation, an erroneous idea of the effect of the operation is likely to be formed, and on the return of consciousness the squint may remain as bad as ever.

Other conditions than hypermetropia which may produce convergent strabismus are— Other conditions causing convergent strabismus.

1. Disease of the brain.
2. Paralysis of the external rectus muscle.
3. Inflammatory or other changes in the internal rectus muscle itself, producing shortening.

In the first two of these no operation is advisable; the third may sometimes be remedied by operative interference.

Divergent strabismus.

Divergent strabismus, as already stated, is often the result of myopia; it is usually consequent on high degrees of the anomaly, and is brought about as follows:—The highly myopic individual requires to bring objects very near the eyes to see them distinctly, consequently a very high degree of convergence is necessary to keep both visual lines directed to the same point; now, not only has a high degree of convergence to be maintained, but in myopia the length of the eyeball and the consequent impairment of its mobility place the internal recti at a disadvantage. Moreover, in order to direct the visual lines of the myopic eyes to the same point, a greater proportionate amount of convergence is required than in emmetropia.

Causes.

As a consequence, the internal rectus of one eye sooner or later becomes wearied and gives in, and the eye deviates outwards, binocular vision being sacrificed.

Cure by glasses.

Treatment.—Many cases of divergent strabismus may be remedied by the use of concave glasses, which enable the individual to see distinctly at a distance up to which convergence of the visual lines can be maintained without undue strain of the internal recti muscles.

If in spite of the use of glasses the divergence continues, it must be remedied by operation. In cases where the eye only deviates outwards, after an object has been looked at for some considerable time, subconjunctival division of the external rectus of the deviating eye may suffice for a cure; but in cases where one or both eyes diverge constantly, and the visual lines can only be made to meet in one point by a great effort, or not at all, the operation of "readjustment" must be performed.

Division of external rectus.

Operation of readjustment.

This operation can be performed as follows:—The patient being placed in the usual position (Fig. 94, p. 340) and thoroughly anæsthetised, the operator should stand behind, fix the lids open with a wire speculum; with scissors make an incision through the conjunctiva and subconjunctival fascia, below the insertion of the external rectus; hook up the tendon, and divide it subconjunctivally close to the sclerotic.

An incision should then be made through conjunctiva and subconjunctival fascia, about midway between the insertion of the internal rectus and inner margin of the cornea, of such a length as to reach about two lines above and a like distance below the margins of its tendon, which should then be hooked up and divided. The muscle and subconjunctival fascia should be freely separated from the parts beneath, and together with the conjunctiva turned back towards the caruncle. Two curved needles holding fine silk should then be passed through the tissues next the margin of the cornea, and the silks firmly tied, two free ends being left; the needles should then be carried from within outwards, through the muscle, subconjunctival fascia, and conjunctiva, as near the inner canthus as possible, and the silk drawn through; a considerable portion of the muscle and other tissues should then be removed with scissors, the free ends of the two fine pieces of silk and the portions to which the needles are still attached then tied firmly together (the eye being rolled well inwards by an assistant as the knots are pulled tight), and the ends of the two sutures cut off close.

Introduction of sutures.

The eye should be bound up with wet lint and a bandage. The sutures will probably require removal in about four or five days, but may be left longer, if they cause no irritation.

Other causes of divergent strabismus.

Divergent strabismus is met with in cases of paralysis of the third nerve, and may also occur in non-hypermetropic eyes if the sight of one has become much impaired, and binocular vision no longer possible. In the former of these cases no operation is advisable; in the latter no improvement of sight is to be expected from readjustment, but the operation may be performed simply to remedy disfigurement.

THE CORNEA.

Affections of cornea requiring operation.

The affections of the cornea which require an operation upon the structure itself are six:—1. Sloughing ulcer. 2. Conical cornea. 3. Corneal opacity. 4. Staphyloma. 5. Lodgment of foreign bodies. 6. New growths.

Paracentesis.

Paracentesis, or tapping the cornea.—This operation is sometimes performed in cases of sloughing ulcer, or suppuration, threatening perforation; by the timely evacuation of the contents of the aqueous chamber a large rupture of the corneal tissue, with its accompanying evils, may in many cases be avoided.

Tapping the cornea may be done thus:—The patient being in the usual position (Fig. 94, p. 340), the operator should stand behind and fix the lids open by a wire speculum or by the fingers. A broad needle should then be passed through the cornea at some convenient part of its margin; when the point of the needle has fairly entered the anterior chamber, its handle should be rotated, so as to bring the breadth of the blade across the incision and thus open it; as soon as the contents of the anterior chamber have flowed out, the needle should be withdrawn, a drop of atropine solution placed between the lids, and the eye bound up in the usual manner.

Iridectomy, however, is to be preferred to paracentesis.

Conical cornea.

Conical cornea ("Staphyloma corniæ pellucidum"), as the name implies, signifies an alteration in the curvature of the cornea, of such a nature that it assumes the form of a cone. The origin of the affection cannot clearly be traced.

The most prominent symptom is gradually increasing myopia, which cannot be remedied by concave lenses. On looking at the cornea in profile, its conical form is very evident.

Ophthalmoscopic appearance.

On examination with the ophthalmoscope by the direct method the apex of the cone, which may, however, be the seat of some opacity, appears brightly illuminated; around this bright portion is a dark ring corresponding to the sides of the cone, this being again succeeded by an area giving a bright reflection, and corresponding to a portion of the cornea which retains more or less its natural curvature.

Objects occupying the fundus of the eye are seen through the apex and sides of the cone near its base, in an inverted position, as in myopia, whilst we obtain a more or less distinct erect image of the same parts through the portion of cornea which still retains its normal curvature. The retinal vessels appear to have a whirl-like motion as we change our point of view from side to side. The appearance is quite characteristic, and once seen is not likely to be forgotten.

Treatment.

Treatment.—Conical cornea can only be remedied by operative interference; two methods of operating are practised, the object of

each being to flatten the cone, and restore to the cornea more or less of its natural curvature.

Removal of apex of cone.

In one operation an elliptical portion including the whole thickness of the cornea is removed from the apex of the cone. The operation can be performed thus (for the position of patient and operator *see* Fig. 94, p. 340):—An anæsthetic should be given, the lids held open by a wire speculum, and the eyeball fixed by seizing with the toothed forceps the conjunctiva and subconjunctival fascia at some point near the corneal margin. A straight cataract extraction knife (Fig. 103 *c*) should then be thrust through the cone from side to side, a small flap formed by cutting out either upwards or downwards, and the flap so made seized with iris forceps and removed with scissors.

In this operation the anterior chamber is opened and the cornea collapses as soon as the first incision is made. Care must be taken that the portion removed includes the most prominent part of the cone, and that the opening left is exactly opposite the pupil.

After the operation the speculum must be very carefully removed, the lids gently closed and bandaged in the usual way; the eye must on no account be examined for a week, so as to give time for the opening in the cornea to fill up. The wound will, in all probability, heal in the course of ten days, the anterior chamber being restored.

Occurrence of anterior synechia.

The margin of the pupil is not unfrequently caught up in the incision, an anterior synechia resulting.

The operation described gives the most satisfactory results, the curvature of the cornea being greatly improved, and a corresponding amount of vision regained.

Removal of portion of thickness of cornea.

In the second operation a superficial portion only is removed from the apex of the cone with a small trephine, a raw surface being left, which by its subsequent cicatrisation and contraction causes considerable flattening of the cone

Tinting.

Tinting the cornea is called for in cases of dense white opacity (leucoma), causing disfigurement. The operation can be performed as follows:

For position of patient and operator *see* Fig. 94, p. 340. An anæsthetic having been given, the operator should place the wire speculum between the lids, fix the globe with the toothed forceps, paint some Indian ink upon the opacity, and prick it thoroughly in with a bunch of needles fixed in an ivory handle; the ink should be sponged away from time to time in order to allow the operator to see what progress he has made.

The opacity having been thoroughly tinted, the speculum should be removed; no bandage need be applied, and no after-treatment is necessary; very little irritation follows. If after the lapse of a week or ten days the opacity do not appear sufficiently blackened, the operation may be repeated.

Repetition of operation.

If the ink be allowed to get into the wound made in the conjunctiva by the toothed forceps, a black mark will be left; care should therefore be taken to fix the globe at a point to which the ink cannot run. Should the anterior chamber be opened, the operation must be discontinued, as the lens may be wounded.

Perforation of anterior chamber.

Staphyloma.

Staphyloma, first so called from its supposed resemblance to a grape, has now come to mean a bulge on any part of the eyeball. On the cornea it is caused either by yielding of its structure or

more commonly by prolapse of iris through a perforation in it, the prolapsed portion being firmly coated over with inflammatory material. Staphyloma is said to be "total" where the whole of the cornea is affected, "partial" when some portion of it retains its normal curvature. Total staphyloma should be removed by abscission (*see* p. 375), or the eyeball may be excised. Partial staphyloma may subside on the performance of iridectomy, or can be removed as follows:—The position of patient and operator should be as at Fig. 94, p. 340, and an anæsthetic should be administered. The lids being kept open by the wire speculum, a curved needle armed with fine silk should be passed through the base of the staphyloma, an elliptical portion of which should then be removed with a straight cataract knife; the silk should then be drawn through and tied, thus bringing the edges of the gap made by the removal of the elliptical portion together, and the eye bandaged in the usual way. The suture may be removed in the course of three or four days.

Total staphyloma.

Partial staphyloma.

Foreign bodies.—Small fragments of metal, chips of stone, thorns, &c., are not unfrequently found lodged in the cornea. To remove them the position of patient and operator should be as Fig. 93, p. 340. As a rule no anæsthetic need be administered. The lids should be kept open by the fore and ring fingers of one hand, and the globe steadied by gently pressing upon it with the second finger; the foreign body should then be carefully lifted from its bed with the point of a knife or small spud held lightly in the other hand. Foreign bodies, especially thorns, are sometimes so firmly and deeply embedded that they require to be cut out.

Removal of foreign bodies.

New growths may be met with springing from the cornea.

New growths.

Congenital tumour is a small white flattened elevation usually situated near the corneal margin, encroaching on both cornea and sclerotic; it lies beneath the corneal epithelium and conjunctiva, and appears to extend pretty deeply into both cornea and sclerotic; the growth is present at birth, but usually increases somewhat as the child grows up. It may give rise to astigmatism by causing distortion of the cornea.

Congenital tumour.

The growth may be single or there may be two or three little tumours. Their structure is that of connective tissue, and occasionally small hairs grow upon them.

Should the little growths give rise to inconvenience they can be shaved off level with the cornea, but as a rule they cannot be entirely removed.

Round and spindle-celled sarcomata have also been met with growing from the cornea. Such cases usually call for extirpation of the eyeball.

THE IRIS.

Iridectomy is called for in all cases in which it is desirable to influence the tension or nutrition of the eyeball; it is associated with some operations for cataract; in a somewhat modified form, is one of the methods of making an artificial pupil, and is useful in some other conditions.

Iridectomy.

The operation is performed (1) to influence tension.

To influence tension in sloughing ulcers.

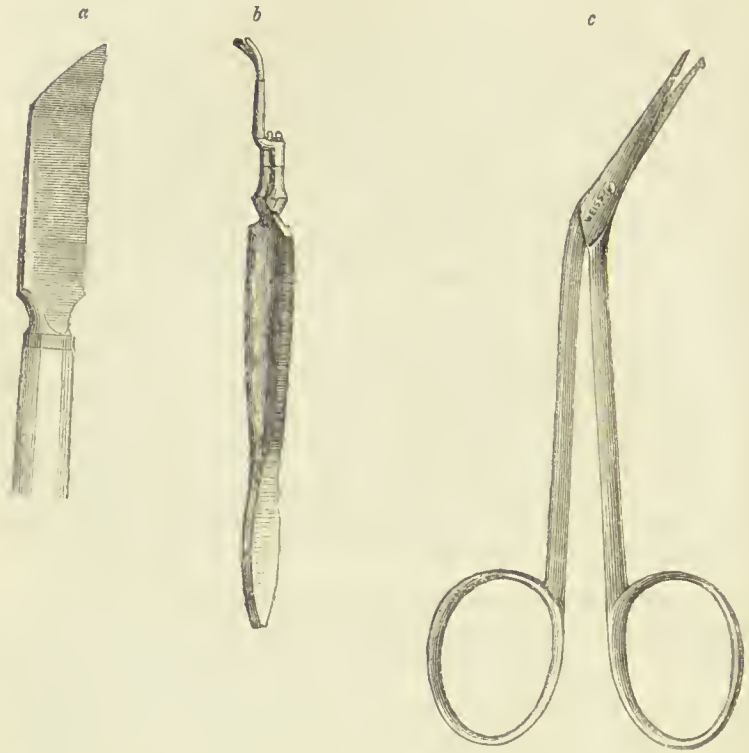
(*a*) *In sloughing ulcers*, or suppuration of the cornea, accompanied by pain, and threatening perforation. In such cases iridectomy gives almost instant relief to the most severe pain, and in all probability will save the cornea from rupture.

For swollen lens.

(*b*) *In injuries of the eyeball,* in which the crystalline lens, being wounded, has become opaque and swollen, and is pressing on surrounding parts, causing severe pain and threatening the integrity of some of

Fig. 100.

Iridectomy instruments.



a. Bent iridectomy knife. *b*. Iris forceps. *c*. Iris scissors.

the delicate structures within the globe. In these cases, not only does iridectomy diminish tension, and so relieve pain, but gives room for any subsequent swelling of the lens.

In corneal staphyloma.

(*c*) *In staphyloma of the cornea* iridectomy often causes complete subsidence of the projection.

In glaucoma.

(*d*) *In glaucoma* a timely and well-performed iridectomy causes instant and lasting diminution of tension and places the eye in comparative safety; the operation should be performed on any eye that can distinguish *bright* light, and to relieve pain in any case whether there be perception of light or not; in acute glaucoma it must be tried even if all perception have been lost for some days.

To influence nutrition.

(2) To influence nutrition, iridectomy should be performed in chronic choroido-iritis, recurrent iritis, and in cases of total exclusion of the pupil, where there is no communication between the anterior and posterior division of the aqueous chamber.

In cataract operations.

(3) Associated with operations for cataract iridectomy should be performed previous to a needle operation if much swelling of the lens be anticipated; or it may require to be done after the needle has been used if pain or increase of tension occur.

The operation should also be performed at some time previous to, or simultaneously with, small flap or linear extraction of cataract.

(4) Iridectomy for artificial pupil is mentioned at another page.

(5) Other conditions in which iridectomy may be required are— Other conditions requiring iridectomy.

(*a*) Hæmorrhage into the vitreous humour.

(*b*) Displacement of the retina.

(*c*) As an aid to the removal of foreign bodies from the globe.

(*d*) Some peculiar conditions of intra-ocular circulation.

Operation of iridectomy. Operation of iridectomy.

Instruments.—A wire speculum (Fig. 97), a straight or bent iridectomy knife (Fig. 100*a*), a pair of toothed forceps (Fig. 99*a*), a pair of iris forceps (Fig. 100*b*), iris scissors (Fig. 100*c*), and a curette (Fig. 103*a*). For the position of patient and surgeon *see* Fig. 94, p. 340. The patient should be brought fully under the influence of an anæsthetic, the lids kept widely open by the wire speculum; and the eyeball fixed by seizing the conjunctiva and subconjunctival fascia near the corneal margin with the toothed forceps; then, with a straight or bent iridectomy knife of medium size an incision should be made in the sclerotic, in such a position that the knife enters the anterior chamber quite at its peripheral part, and close to the anterior surface of the iris. Instruments required.

The knife, having entered the anterior chamber, should be pushed steadily on (care being taken to keep its point well forwards towards the cornea, so as not to wound the lens), until the point is opposite the centre of the pupil. The point should then be turned to one side, so as to be out of the pupillary area, and the knife slowly and gently withdrawn, the hold of the forceps being let go at the same time. The incision thus made should be of such a length as to correspond to a little more than one fourth of the circumference of the iris.

The next step in the operation is the removal of a portion of the iris. If, as is not unfrequently the case, the iris has become prolapsed, it needs only to be seized with the forceps, and a piece of the desired size removed with the scissors. If the iris does not protrude, the iris forceps should be introduced shut, through the wound in the sclerotic, and pushed on until the extremities of their branches are opposite the nearest portion of the pupillary margin; they should then be allowed to open of themselves, when the iris will be pushed between the branches by the pressure of the parts behind; no backward pressure must be made with the forceps, but they should be gently closed again and withdrawn, carrying the iris with them, which should then be cut across with the scissors, close to one angle of the wound, drawn over to the other angle, and a piece cut off; the curette should be passed between the lips of the wound so as to push back any portions of iris that may have become entangled in it. The eye should then be bound up with lint and a bandage. The form of the pupil after a well-performed iridectomy should resemble Fig. 102 D. Removal of portion of iris. Introduction of forceps.

With regard to the position of the portion of the iris to be removed, opinions are at variance. If the surgeon be a skilful and experienced operator, and has the aid of a competent assistant, the iridectomy should be done upwards, so as to place the gap beneath the upper lid, and thus conceal it as much as possible. Position of portion of iris removed.

Iridectomy upwards.

To perform iridectomy upwards, a bent iridectomy knife should be used, and the incision made in the sclerotic above the upper margin of the cornea, an assistant should then draw the eyeball downwards with forceps, the iris forceps should be inserted, and the portion of iris removed as previously directed.

Iridectomy downwards and outwards.

An inexperienced operator will find it much easier to remove the portion of iris from its outer and lower segment. In this case a straight iridectomy knife can be used, and no assistant is required. The result is rather an ugly gap; the disadvantage of which, however, is quite counterbalanced by the ease and safety with which the operation can be performed.

Accidents during iridectomy.

Accidents which may happen during the operation of iridectomy, and difficulties which may be encountered.—The accidents which may occur are—

Wound of lens.

(1) Wound of the lens from insufficient care in keeping the point of the knife well forward, and out of the area of the pupil. This accident will, in all probability, be followed by the formation of traumatic cataract.

Loss of vitreous.

(2) Escape of vitreous humour, is very likely to occur in hard eyes, if the knife be too quickly withdrawn, or if undue pressure be exerted on the globe with the forceps.

Detachment of iris from insertion.

(3) The iris may be torn away from its insertion at a point opposite to the incision, if undue traction be exercised upon it with the iris forceps.

Difficulties.

Difficulties.—The iris may be found so rigid that it cannot be seized with the forceps, or so rotten that only very small portions can be brought away; sometimes it bleeds profusely when touched, filling the anterior chamber with blood, and considerably hindering the operation.

Artificial pupil.

Artificial pupil.—The operation for artificial pupil is performed to open a new path for rays of light to the retina, the natural passage being obstructed.

It is indicated in the following cases:—(1) In opacity of the cornea, with or without anterior synechiæ. (2) In closure of the pupil. (3) In extensive posterior synechiæ. (4) In central opacity of the lens or its capsule.

Position of new pupil.

The artificial pupil must be small, as nearly central and as well defined as possible. Care must be taken to make it behind that portion of the cornea which is most transparent and least altered in curvature, the best situation being ascertained by oblique illumination. The new pupil must not be made upwards, or it will be covered by the upper lid.

Methods of making artificial pupil.

An artificial pupil can be made in any of the following ways:—(1) By incision of the iris. (2) By tearing it away from its insertion. (3) By excision of a portion (iridectomy for artificial pupil). (4) By ligature.

In operations for artificial pupil the position of patient and surgeon should be the same as in "iridectomy," and an anæsthetic should be administered.

Incision.

I (*a*). *Incision* (Fig. 102 A).—This operation is called for in cases of complete closure of the pupil, following removal of the lens, either by operation or injury, but is not advisable unless the lens be absent. In

these cases the iris may be found changed into a tense, unyielding membrane, which cannot be seized with forceps.

The operation of "incision" may be performed either by thrusting a broad needle through the cornea near its margin, and then incising the iris, so as to cut across its radial fibres; or an incision having been made with an iridectomy knife in the sclero-corneal margin, a pair of scissors (having one sharp and one blunt-pointed blade) may be introduced through the wound, one blade being thrust through the iris at its nearest point and passed behind it, the other carried along its anterior surface, and the iris then cut fairly across from one side to the other.

Whichever plan of incision is adopted, the vitreous humour pushes forward into the wound and keeps its edges widely separated, a pupil resembling Fig. 102 A being formed.

Two other methods of making an artificial pupil by "incision" have been lately introduced; they are known as single and double "iridotomy." Iridotomy.

For the positions of patient and surgeon in performing either of these operations, *see* Fig. 94, p. 340.

(*b*). *Single iridotomy* should be thus performed:—The eyelids being kept open with the wire speculum, and the eyeball fixed by seizing the conjunctiva and subconjunctival fascia, close to the margin of the cornea at its inner side, an incision should be made with an iridectomy knife in the cornea, about midway between its margin and the pupil, and opposite to the point of fixation with the forceps. The forceps scissors (Wecker's, Fig. 101) must be then introduced closed through the wound into the anterior chamber, the blades opened, one passed through the pupil behind the iris, the other on its anterior surface, and the sphincter of the pupil be divided with one sharp cut. The Wecker's scissors.

Fig. 101.



Wecker's scissors.

scissors should then be withdrawn, any prolapse of iris that follows replaced with the curette, a drop of atropine placed between the lids, and the eye lightly bandaged.

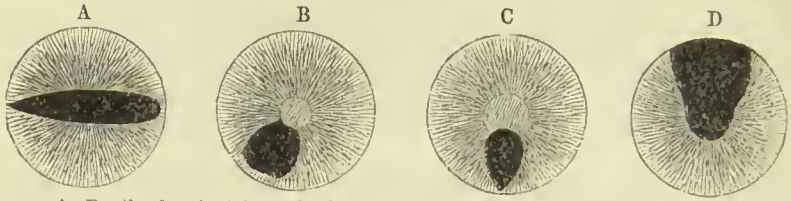
This operation is applicable to cases where the lens is present, its centre being opaque and its peripheral portion clear.

(*c*). *Double iridotomy* is applicable to cases of closed pupil after cataract extraction. An incision should be made through the upper part of the cornea, the knife carried through the iris and along its posterior surface, so as to make a fair-sized wound in it; the incision being finished the knife should be carefully withdrawn, and, very possibly, some vitreous humour will follow it. Double iridotomy. Escape of vitreous.

The next step in the operation is to pass the forceps scissors, closed, through the wound in the cornea into the anterior chamber, open them, pass one blade behind the iris, the other in front of it, make an incision in a direction downwards and inwards; then change the direction of the scissor blades and make a cut downwards and

outwards. Thus a small piece of iris is enclosed by a V-shaped incision, the apex of the V being upwards. The small portion of iris contracts up, and a somewhat triangular pupil is left. The eye should be bound up as usual.

Fig. 102.



A. Pupil after incision. B. Pupil after excision. C. Pupil after ligature. D. Iridectomy for glaucoma, &c.

Iridodyalisis.

(2) **Tearing away the iris from its insertion (Iridodyalisis).**—An incision having been made through the cornea on the side opposite to that on which the iris is to be removed, a pair of iris forceps should be passed through the wound and across the anterior chamber, the iris seized close to its greater circumference, and torn forcibly away from its insertion; the instrument should then be carefully withdrawn and the eye bound up. If necessary, the whole iris may be removed in this way. This operation is applicable to cases of dense corneal opacity (leucoma), occupying the whole of its central part, some transparent cornea being left at the margin.

Iridectomy for artificial pupil.

(3) **Excision—Iridectomy for artificial pupil.**—An incision should be made of the requisite size, through some part of the sclero-corneal margin, the iris forceps introduced through the wound, the ends of their branches passed fairly up to the margin of the pupil, the iris seized and drawn out through the wound, and a small portion removed with scissors. The curette should then be passed between the lips of the wound so as to push back any portion of iris that may have become entangled in it; a pupil resembling Fig. 102 B should be formed.

Iridesis.

(4) **By ligature (Iridodesis, or Iridesis).**—An incision should be made with a broad needle near the margin of the cornea, a small noose of silk laid upon the surface of the eyeball so as to encircle the incision; an iris hook or cannular forceps then passed through the noose and wound, and the iris drawn gently out; an assistant with two pairs of broad-ended forceps should seize each end of the noose and firmly ligature the included portion of iris; the ligature will drop off in the course of a few days, a pupil resembling in shape Fig. 102 C being left.

THE CRYSTALLINE LENS.

Cataract.

By cataract we understand an opacity of the crystalline lens.

Causes of cataract.

The causes of this opacity are somewhat obscure, but it probably depends on impairment of nutrition of the lens consequent on senile decay or constitutional conditions (*e. g.* diabetes).

It also occurs in connection with inflammatory changes in adjacent parts—the choroid, ciliary body, vitreous, and iris; is met with as a congenital defect, and very frequently results from injury.

Forms of Cataract.

There are two principal forms of cataract: Forms of cataract.

(1) *The cortical or soft cataract.*

(2) *The nuclear or hard cataract.*

In the first form the cortical substance of the lens is primarily affected, the nucleus afterwards becoming opaque, the whole being soft, or even fluid.

In the second the nucleus of the lens first becomes hard, yellowish, and opaque, the cortical substance being subsequently affected.

The cortical cataract is met with as an idiopathic disease in childhood and early adult life, and as the result of injury at all ages. Cortical cataract.

There are several varieties of cortical cataract.

(*a*) *Zonular or lamellar cataract* is either congenital or commences soon after birth; it is characterised by an opacity of circular form and well-defined outline, situated in the cortical substance of the lens, but at some distance from its surface; the margin, nucleus, and superficial layers of the lens are transparent. Zonular cataract.

(*b*) *Ordinary congenital cataract* is a bluish-white opacity of the whole lens.

(*c*) *Traumatic cataract* is an opacity of the lens often accompanied by swelling, and caused by rupture of its capsule from injury, and the subsequent action of the aqueous humour upon its substance. Traumatic cataract.

(*d*) *Posterior polar cataract*, an opacity situated at the posterior pole of the lens; and— Posterior polar cataract.

(*e*) *Entirely fluid or diffluent cataract* are caused by changes in the lens, secondary to inflammation of adjacent parts. Diffluent cataract.

The variety of cataract met with in diabetes is composed principally of soft material; but if the patient be advanced in years there is usually a hard nucleus.

Nuclear cataract occurs in persons who have passed the middle period of life, and is characterised by the presence of a hard yellowish central portion or nucleus of varying size and density; the nucleus is surrounded by more or less soft cortical substance, and is occasionally of a greenish, or almost black colour, giving rise to what is known as *green or black cataract.* Nuclear cataract. Black cataract.

Diagnosis of cataract.—The existence of cataract is easily ascertained by oblique illumination, the pupil having been dilated with atropine previous to making the examination. Diagnosis of cataract.

Treatment.—The treatment of cataract is entirely operative, no kind of medication being of the least use. Treatment.

Our object in performing an operation is to open a path for rays of light to pass to the retina. This can be attained in one of two ways, the method adopted depending on the kind of opacity present.

(1) In cases (as lamellar cataract) where the bulk of the lens is clear, the opacity being situated in the axis of the normal pupil, very useful vision is procured by making an artificial pupil, opposite a transparent portion of the lens (*see* Artificial Pupil).

(2) When the whole lens is opaque, its entire removal must be accomplished.

Three varieties of operation are performed to secure the removal of the whole lens: Varieties of operations.

(1) The operation for solution or absorption.
(2) Extraction.
(3) Suction.

Forms of cataract to which each is applicable.

Forms of cataract to which each operation is applicable.—As a broad rule, cataract occurring in persons below twenty is of the soft or cortical form, and should be removed by *solution* or *suction;* cataract occurring in persons above thirty (excepting traumatic cataract) is of the hard or nuclear form, and must be removed by extraction.

In the intermediate decade a doubt may arise as to what is the best plan of procedure; in these cases the surgeon must be guided by the general appearance of the cataract; if it appears bluish in colour, and somewhat swollen, it is probably soft and can be removed by *solution* or *suction;* if there is a distinct yellow reflection from its centre, denoting the presence of a hard nucleus, it should be removed by *extraction.* It must also be borne in mind that loss of time is a very serious consideration with most patients, consequently a preference must always be given to that operation which will allow him to resume his occupation as early as possible.

Solution, though perhaps somewhat safer than extraction, is always a tedious process, and the more so the older the patient; consequently, preference must be given to extraction in all cases where the condition of the patient's sight is such as to prevent him following his occupation, even though there be no appearance of a hard nucleus. In cases where the cataract is evidently soft, and one eye retains useful vision, solution is to be preferred to extraction, as the patient can continue at his work during the time that absorption is going on.

Before performing any operation for cataract we must take care to ascertain that the eye has good perception of light, indicating that the retina is in a normal condition; otherwise no improvement of vision will result from removal of the lens.

Operations for Removal of Cataract.

Solution.

Solution.—In the operation for solution the capsule of the lens is opened, and its substance thus allowed to be acted upon by the aqueous humour, by which it is broken up and softened, absorption finally taking place.

The operation can be performed as follows (for the positions of patient and operator *see* Fig. 94, p. 340):—No anæsthetic is needed; the pupil should be well dilated with atropine; the operator, keeping the eyelids separated by the fore and ring fingers of one hand, and steadying the globe by pressing the second finger gently upon it, should take a cataract needle in the other hand and pass it obliquely through the cornea at such a distance from its centre that any resulting cicatrix will not interfere with vision; the needle should then be pushed on across the anterior chamber into the area of the pupil; its point then depressed and three or four incisions made with it in the lens-capsule, so as to divide it freely. Care must be taken to use the needle very gently, and not to pass it too deeply into the lens, otherwise the suspensory ligament may be torn and the lens displaced.

Precautions to be taken.

The capsule having been freely divided, the needle should be carefully withdrawn and a drop of solution of atropine placed between the lids; the only after-treatment required is the constant use of atropine, so as to keep the pupil widely dilated.

If the eye be examined in the course of a few days white flocculent lens matter will be seen protruding through the opening in the capsule into the anterior chamber, showing that the lens is swelling and undergoing solution.

Operation requires to be repeated.

The operation will probably require to be repeated in about a month or six weeks, and possibly on one or two subsequent occasions, before the whole lens is absorbed. Care must be taken not to do too much at one sitting, or the lens may swell too rapidly and press upon the surrounding parts, giving rise to severe pain, increased tension of the globe, iritis, cyclitis, &c.

Extraction of cataract.

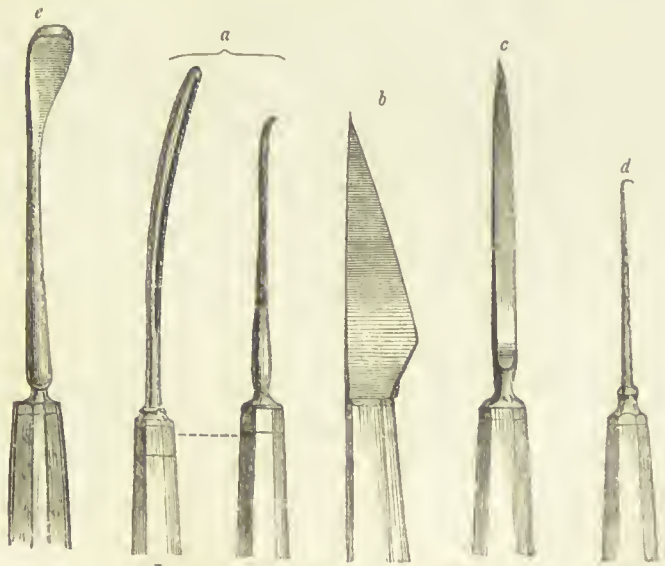
Extraction of cataract.

The object of operations for extraction of cataract is the removal of the lens through an incision altogether in the cornea or partly in the sclero-corneal margin or sclerotic, the incision being either simple or associated with excision of a portion of iris.

Extraction can be best performed by one of the five following methods:—(1) Flap extraction, (2) small flap with iridectomy, (3) extraction by oblique corneal section, (4) linear extraction, (5) extraction by means of a traction instrument. In the first and third methods no iris is removed; in the second, fourth, and last iridectomy should be performed either at the time of removal of the lens or some weeks or months previously. All entirely opaque lenses (mature cataracts) may be removed by the first or third methods; all partially opaque lenses (immature cataracts) must be extracted by the second or fourth, a traction instrument being used in any case where great difficulty is encountered, or where escape of vitreous has taken place before the lens has been extracted.

FIG. 103.

Extraction instruments.



Instruments for extraction of cataract.
a. Curette and pricker. *b*. Triangular cataract knife. *c*. Straight cataract knife (Graefe's). *d*. Sharp hook. *e*. Scoop.

We shall, however, find that in all cases we obtain most uniform success by extraction associated with iridectomy; we should never

attempt to extract an immature cataract without first excising a portion of iris, and it is well to do so as a preliminary some weeks before the lens is removed.

Flap extraction.

Flap extraction.

The instruments required for flap extraction are a triangular cataract knife, sharp hook, and curette (Fig. 103 *b*, *d*, *a*).

For the positions of patient and operator *see* Fig. 94, p. 340. No anæsthetic is required; the patient should be requested to look downwards, the lids kept open and the eyeball steadied by the operator's fingers as in the operation for solution.

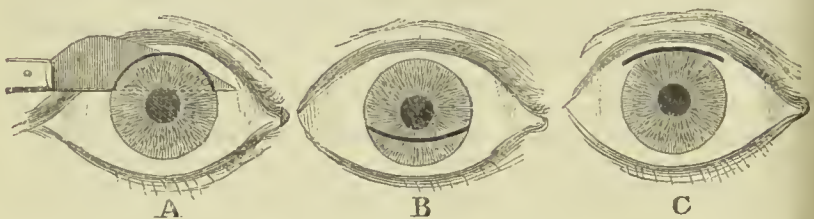
Method of making section.

The incision should be made by passing a triangular cataract knife through the outer margin of the cornea, at a point just above its horizontal meridian, into and across the anterior chamber, bringing it out through the cornea at a corresponding point on the inner side, and completing the section by pushing the knife onwards until its heel cuts out along the upper margin of the cornea. (Fig. 104 A.)

This simple onward movement of the knife is sufficient if the incision

Fig. 104.

Incisions for extraction.



Incisions for extraction of cataract.—A. Flap. B. Oblique corneal section. C. Linear incision.

has been properly planned, but should the cornea have been entered too low down, the knife will not be wide enough to cut out, and then the section must be completed by slightly withdrawing the blade or by a sawing movement. Care must be taken not to withdraw the knife until it has passed some distance through the opposite side of the cornea, or the aqueous humour will escape too soon, and the iris fold over the edge of the knife and be wounded.

If the incision has been properly made a semicircular flap, including a little less than half the cornea, will be formed.

The section having been finished, the patient should close the eyes gently, and be allowed to rest for a moment.

Removal of the cataract.

The next step in the operation is the removal of the opaque lens. The upper lid being drawn gently upwards and the patient directed to look downwards, the sharp hook must be introduced through the wound and the lens capsule lacerated by gently scratching it; the hook should then be withdrawn, and the patient allowed to close the eyes for a short time.

The eyes should then be gently opened, and the lens removed by lightly pressing the lower lid against the globe, just below the inferior margin of the cornea, with the thumb of one hand, counter-pressure being similarly applied with the forefinger of the other hand at a corresponding point above. If the manœuvre be properly executed the pupil gradually dilates, the lens slips gently through it into the anterior chamber and then escapes by the corneal wound. Any pro-

lapse of iris that may occur must be carefully returned with the curette; each eye should then be covered with two pieces of wet lint and a light bandage applied.

Small flap with iridectomy. Small flap.

A flap section should be made by transfixing the eyeball through the sclero-corneal margin with the straight extraction (Graefe's) knife (Fig. 103 c), and then cutting out in the line of the sclero-corneal junction.

The section may be made either upwards or downwards, and the point of transfixion should be about one third of the distance from the horizontal corneal meridian to the upper or lower margin of the cornea. The steps of the operation, with the exception of the incision, are exactly similar to those of linear extraction (see p. 370), but should it be thought fit to perform the operation without anæsthesia, no speculum or fixing forceps should be used.

Oblique corneal section. Oblique corneal section.

This operation often goes by the name of Bader's or Liebreich's operation, when the section is made downwards; Lebrun's "extraction by small median flap," when the section is made upwards. It seems to me that the term "oblique corneal section" expresses all and dispenses with much unnecessary prolixity.

The instruments required are a thin straight cataract knife, a sharp hook, and curette (Fig. 103 *c*, *d*, *a*). (For the position of patient and surgeon *see* Fig. 94, p. 340.) No anæsthetic is required, and, with the exception of the incision, the steps of the operation are much the same as in flap extraction.

The incision may be made either upwards or downwards (Fig. 104 B), by passing the straight knife through the sclero-corneal margin on the outer side at a point (puncture) corresponding to the horizontal corneal meridian into and across the anterior chamber, out at a corresponding point on the inner side (counter-puncture), and then cutting forwards by a sawing movement, *obliquely*, through the cornea, midway between the pupil and upper or lower corneal margin; the former if the incision is made upwards, the latter if it is made downwards. In entering the knife and passing it across the anterior chamber, care must be taken to keep its edge directed forwards towards that part of the cornea which it is desired to incise; if the knife be rotated in any way after the anterior chamber has been opened, the aqueous humour will escape and the blade become entangled in the iris. Method of making incision.

The capsule should be lacerated and the lens removed in the same way as in flap extraction; the position of the incision near the centre of the cornea, however, will not allow the lens to be pressed out immediately, as is done in the flap operation.

Before attempting to squeeze out the cataract its margin must be brought opposite the incision by gently pressing upon the globe above or below, according as the section has been made upwards or downwards. Removal of the cataract.

The bulk of the cataract having been removed, care must be taken to get away any soft cortical substance or fragments of lens that may be left. The soft matter can be removed by gently rubbing the cornea; small hard fragments must be drawn out by the curette or a small scoop. The whole of the cataract having been removed, the Treatment of soft matter.

iris, which will in all probability have somewhat prolapsed, must be replaced with the curette, and both eyes carefully bandaged.

Linear extraction.

Linear extraction.

In this operation the cataract is removed through a linear incision, partly in the sclerotic and partly in the cornea, or altogether in the former; usually associated with iridectomy, performed at the time of extraction of the cataract, or some months previously.

By linear incision is generally understood an incision made in the same direction as a straight line drawn from the centre of curvature of the cornea to its circumference (one of its radii). Many modifications of linear incision are practised, but only one will be described here.

Instruments required.

The instruments required for linear extraction are a wire speculum (Fig. 97), toothed forceps (Fig. 99*a*), a straight cataract knife, a curette, sharp hook (Fig. 103 *c*, *a*, *d*), iris scissors, and iris forceps (Fig. 100 *b*, *c*).

Employment of anæsthetic.

Method of making incision.

The operation should be performed thus, and, as in the other forms of extraction, the incision may be made either upwards or downwards (for position of patient and operator *see* Fig. 94, p. 340):—The patient should be thoroughly anæsthetised, the lids kept open by a wire speculum, and, supposing the incision to be made upwards, the globe must be drawn gently downwards with the toothed forceps, holding the conjunctiva and subconjunctival fascia close to the lower margin of the cornea; then with the straight cataract knife puncture and counter-puncture should be made in the *sclerotic*, just beyond the sclero-corneal margin, the knife entering at a point on the outer side of the globe, situated about two thirds of the way between the horizontal meridian of the cornea and its upper margin, and emerging at a corresponding point on the inner side; the edge of the knife should then be directed nearly straight forwards, and by a sawing movement made to cut its way out through the cornea, at a short distance from its upper margin. (Fig. 104 C.)

If iridectomy has not been previously performed, a piece of the iris should next be excised from the upper segment. (*See* Iridectomy.)

Laceration of capsule.

The next step is to lacerate the capsule. The operator should fix the eye, and draw it gently downwards with the toothed forceps, then introduce the sharp hook through the incision and freely lacerate the capsule with it. The cataract can then be removed by making gentle pressure with the curette upon the eyeball, near the lower margin of the cornea, the globe being steadied and held in position by fixing the conjunctiva with the toothed forceps.

Removal of soft matter, &c.

The nucleus and bulk of the cataract having escaped, the curette should be passed gently over the surface of the cornea from all directions towards the incision, so as to press out any cortical substance that may be left, and if any blood or portions of lens remain in the incision they must be carefully removed, so as to insure perfect coaptation of its margins; the speculum should then be removed, and both eyes bandaged in the usual way.

The incision for linear extraction, as already stated, may be made downwards as well as upwards, the former method of operating being much the easier, and not requiring the aid of an assistant.

The same objections apply to extraction downwards as to iridectomy in the same direction, but the results obtained are equally good as from upward sections and the ease with which the operation can

be performed quite counter-balances any objections which may be made on the score of disfigurement.

Extraction of cataract by a traction instrument. Extraction by traction.

Cataract can be removed by a traction instrument, either through a flap section or a linear incision peripherally situated, iridectomy being performed in either case.

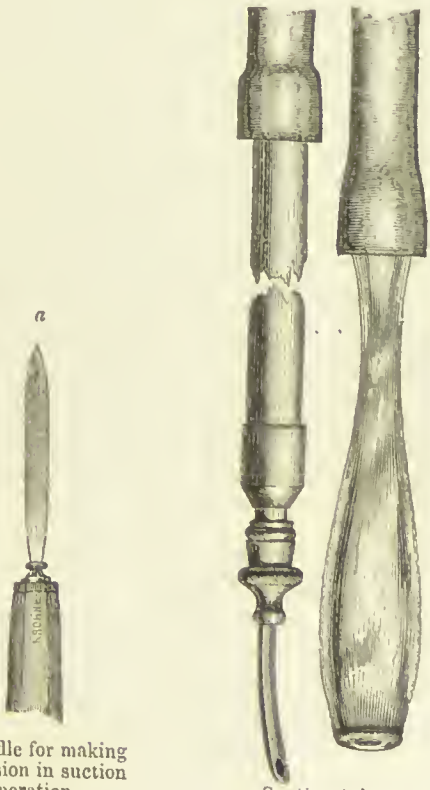
The patient should be thoroughly anæsthetised, and, whichever incision is made, the eyelids should be kept open with the speculum, and the globe fixed with the toothed forceps, while the section is made and during the subsequent removal of the lens.

The traction instrument employed is either a scoop or a sharp hook (Fig. 103 *e*, *d*).

Removal of cataract by the scoop (scoop extraction).

Scoop extraction can be accomplished thus:—The section having been made and iridectomy performed, the convex surface of the scoop should Scoop extraction.

Fig. 105. *b*



a

Needle for making incision in suction operation.

Suction tube.

be pressed gently upon the more peripheral margin of the incision, so as to cause it to gape somewhat; the instrument should then be passed with the utmost gentleness through the incision, beneath the margin of the lens, along its posterior surface and beyond its posterior pole, until the lens lies well in its concavity, and it should then be care-

fully withdrawn, carrying the cataract with it, the removal being assisted by gentle pressure on the exterior of the globe.

Sharp-hook extraction.

Removal of cataract with the sharp hook (sharp-hook extraction).

The hook should be passed well behind the lens in the same manner as the scoop, fixed into its posterior surface, and then carefully withdrawn, carrying the lens with it. Two sharp hooks may be used instead of one, and should be fixed into the lens at different points, so as to prevent it rolling round (as sometimes happens when only one hook is used), instead of passing in the desired direction.

After removal of the lens by either method both eyes should be bound up in the usual way.

Suction.

Suction.—The removal of cataract by suction is indicated in cases where the lens has become nearly or entirely fluid, as occurs in many instances of traumatic cataract, and frequently after a needle operation has been performed.

Instruments required.

The instruments required are a wire speculum, toothed forceps, broad needle, and suction tube (Figs. 97, 99*a*, 105 *a*, *b*). Before operating, the pupil should be well dilated with atropine. (For position of patient and surgeon *see* Fig. 94, p. 340.)

It is best, but not absolutely necessary, to place the patient under the influence of an anæsthetic. The lids should be kept open by a wire speculum, the eyeball fixed by the toothed forceps, and a small linear incision made in the cornea with the broad needle, about midway between its summit and margin, in any convenient position.

Method of using suction tube.

The operator should then place the mouth-piece of the suction tube in his mouth, pass its nozzle through the incision and behind the softened lens, and, by sucking gently, remove as much lens matter as will come away easily. No force must be used, and if any portion of the lens be too hard to pass easily into the tube it may be left to become absorbed or be dealt with on a future occasion. When as much lens as will easily come away has been extracted the suction tube should be removed, the speculum taken out, a drop of solution of atropine placed between the lids, and the eyes bandaged in the usual way. The bandage should be continued, and the pupil kept dilated with atropine, until all irritation has subsided.

Accidents during Extraction of Cataract.

Accidents which may happen.

Premature escape of aqueous humour.

If care be not taken in making the section the aqueous humour may escape too soon, and the movements of the knife be hampered by the iris falling forwards. Should this happen, the knife must be carefully withdrawn and the section completed with scissors.

Bleeding into anterior chamber.

Bleeding into the anterior chamber.

In some cases hæmorrhage from the cut iris takes place to such an extent as to fill the anterior chamber with blood and hide the cataract entirely from view.

If the blood does not flow out easily on placing the curette between the lips of the incision and making gentle pressure on the cornea the operation should be discontinued, the eye bound up, and left till the blood has become absorbed, unless the lens-capsule has been lacerated, in which case the lens *must be removed at all risks*, or it may swell, press upon surrounding parts, set up inflammatory action,

cause increase of tension of the globe, and very probably lead to destruction of the eye.

Prolapse of vitreous humour. Prolapse of vitreous.

If any undue pressure be exerted on the globe during extraction the suspensory ligament of the lens gives way and a prolapse of vitreous follows. Should the prolapse of vitreous occur before the escape of the lens the cataract should be removed as quickly and gently as possible by the aid of a scoop or sharp hook.

Prolapse of vitreous is more likely to occur if the humour is abnormally fluid. The accident may give rise to no bad results, but is sometimes followed by a form of chronic choroiditis which ultimately destroys the eye.

If vitreous has been lost great care must be taken to bandage the eye so as to keep the lids immovable and prevent them pressing upon the globe and causing further prolapse.

Displacement of the cataract. Displacement of the cataract.

In some cases, on an attempt being made to press out the lens, the suspensory ligament gives way, and the cataract, instead of coming forwards into the anterior chamber passes behind the iris or sinks backwards into the vitreous chamber; it should, if possible, be removed by the scoop or sharp hook. If left within the globe it will probably act as a foreign body, set up inflammation, and destroy the eye.

After-treatment of Extraction of Cataract. After-treatment.

Immediately after the operation each eye should be covered with two folds of wet lint secured by a bandage, which has been contrived for the purpose by Mr. Dunnage,[1] of the Central London Ophthalmic Hospital The patient should then be put to bed, where he should remain for three or four days.

The lint must be kept constantly wet, and fresh pieces should be applied every two or three days.

On no account should the eye be examined until the end of the first week; if the lids remain in a normal condition we may rest assured that all is going on well, and opening the eye too early can do no good, and may do a great deal of harm. Condition of eyelids.

At the end of a week the eye may be opened and its condition ascertained. Should the section be healed, the anterior chamber re-established, and no signs of inflammatory action present, the sound eye can be safely left uncovered, the one that has been operated on being kept bandaged as before, and a large green shade worn over both. At the end of three weeks the bandage may be removed from the eye on which extraction has been performed, but the shade or protectors should be worn until all undue vascularity has subsided. Bandage may be removed.

At the end of about two months (if there be no intolerance of light or irritability of the eye) glasses should be ordered, two pairs being given; one for going about, and one for reading; convex 13 D will usually be found most suitable for the former purpose, convex 16 D for the latter. But should the patient have been myopic or hypermetropic before the operation, glasses weaker or stronger than these may be required. Glasses may be ordered.

[1] Dunnage's bandage consists of a piece of material of an open texture—through which water will easily run—of such a length as to cover both eyes, and leave some to spare. To each end of this piece are attached tapes by which the bandage is secured.

This is the usual course of cases of extraction of cataract; all do not, however, go on so favorably.

A day or two days after the operation the patient may complain of severe pain in the eyeball, temple, and brow, and on removing the bandage the lids may be found puffy and red, or perhaps much swollen.

Symptoms of inflammation.

These symptoms always indicate inflammatory changes in some of the ocular structures; the inflammation may be simply an attack of iritis, which will probably proceed to a favorable termination; but may subsequently affect the choroid, a chronic form of choroido-iritis being set up, which leads to softening, and eventually to shrinking of the globe; the cornea may be inflamed or suppurating, or inflammation and suppuration of all the ocular structures (panophthalmitis) may have set in. For the treatment of these cases *see* Iritis, Corneitis, &c.

Occurrence of entropion.

A not uncommon cause of pain and irritation is the occurrence of entropion of the lower lids; this must be remedied by operation (*see* Operations on the Eyelids).

Causes of Unsatisfactory Results of Cataract Extraction.

Closure of pupil.

The result of an operation for extraction of cataract may be marred by closure of the pupil consequent on iritis, by obstruction of its area with opaque lens capsule, or by opacity of the vitreous humour.

Capsular obstruction.

Occlusion of the pupil should be remedied by making an artificial one (*see* Artificial Pupil); capsular obstructions should be torn through with cataract needles, cut across with scissors, or removed bodily with forceps.

The greatest caution must always be exercised in meddling with opaque capsule as an operation upon it, especially an attempt to tear it forcibly away, is very likely to be followed by increase of tension, inflammation, or even suppuration of the eyeball.

Opacity of vitreous.

For opacity of the vitreous humour nothing can be done.

EXTIRPATION OF THE EYEBALL.

Extirpation of eyeball.

Removal of the eyeball is called for under the following conditions:

Cases in which the operation is called for.

(1) In all cases of injury causing complete disorganisation, with collapse of the globe and escape of its contents.

(2) In cases where one eye, having been damaged by injury or disease to such an extent as to render it *practically useless*, becomes irritable or painful, and the sound eye appears threatened by sympathetic ophthalmia.

(3) In cases where an eye lost from injury or disease, and *quite blind*, is a source of annoyance, even though the other eye be not threatened.

(4) In cases where the globe has become the seat of malignant disease.

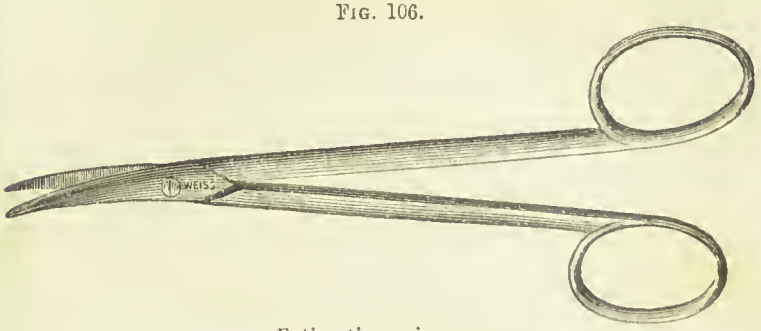
Operation of extirpation.

Extirpation of the eyeball should be thus performed (for position of patient and operator *see* Fig. 94, p. 340):—The instruments required are a wire speculum, toothed forceps, a pair of blunt-pointed scissors, curved on the flat (Fig. 106) and a strabismus hook. The patient being thoroughly under the influence of an anæsthetic, the operator should place the wire speculum between the lids, then by the aid of the forceps and scissors cut through the conjunctiva all round the cornea as close to its margin as possible; he should then, with the stra-

Division of the conjunctiva.

bismus hook, take up the four recti muscles, one after the other, and divide them with the scissors, either the external or internal rectus Division of the muscles.

Fig. 106.



Extirpation scissors.

Extirpation scissors.

being cut at a little distance from the globe, so as to afford a hold for the forceps in the subsequent steps of the operation, and the other three muscles as close to it as possible.

The muscles having been divided, the hook should be made to sweep round the globe, so as to be sure that nothing is left uncut. By pressing the speculum backwards the eyeball will become dislocated in front of the lids, and then being steadied by holding the piece of muscle purposely left, with the forceps, the scissors should be passed behind it until their points are found to be in contact with the optic nerve, then slightly withdrawn, opened widely, pressed forwards again, and the nerve divided by a single cut. Division of optic nerve.

As soon as the nerve has been cut through, the eyeball will be almost free, being held only by the oblique muscles, which should be divided close to the sclerotic. Should there be free hæmorrhage the speculum may be left between the lids, a piece of sponge pressed firmly into the orbit, and secured by a turn of bandage; when all bleeding has ceased the sponge should be removed with the speculum, and two small pads of wet lint and a bandage applied. Should the hæmorrhage be but slight two or three small pads of wet lint must be laid over the closed lids, and secured by a bandage in the same manner as in other operations on the eye. In about a month or six weeks an artificial eye may be ordered. Artificial eye.

ABSCISSION.

Abscission.

Abscission is the removal of that portion of the eyeball (including the ciliary region) situated in front of the attachments of the recti muscles, these being left intact. The object of this operation is to leave a movable stump, on which an artificial eye can rest and be moved in harmony with the movements of the sound one.

Abscission is indicated in staphyloma occupying the whole or greater part of the former situation of the cornea, the remainder of the globe retaining its normal curvature. Cases to which it is applicable.

The operation should be thus performed (for position of patient and operator *see* Fig. 94, p. 340):—The instruments required are a wire speculum, toothed forceps, strabismus scissors, a triangular cataract knife, a curved needle and silk. The patient being thoroughly under the influence of an anæsthetic, the wire speculum should be placed The operation.

between the lids, the conjunctiva divided all round close to the corneal margin (as for extirpation), and dissected back to the desired extent.

Then with the curved needle a single suture should be passed from side to side across the front of the eyeball through both edges of the divided conjunctiva, and the silk left hanging in a large loose loop on the patient's face.

The staphyloma, the whole of the ciliary body, and sclerotic corresponding to it, should then be removed by transfixing the globe with the triangular knife just in front of the insertions of the internal and external recti muscles, cutting out upwards in front of the insertion of the superior rectus, and finishing the removal by a sweep of the knife in the opposite direction.

The silk should be then drawn up and tied, by which means the conjunctiva will be made to cover the wound in the globe, and wet lint and a bandage applied. As soon as the parts have firmly healed an artificial eye may be worn.

Abscission should be performed in preference to excision of the globe in children; the presence of the stump left prevents to a great extent the shrinking, or non-development, of the orbit which will occur if the eyeball be removed entirely.

In older persons excision is generally to be preferred, as the stump left after abscission is very liable to become troublesome, and in the very old is prone to suppurate.

AFFECTIONS OF THE ORBIT.

Protrusion of the eyeball.

Protrusion of the Eyeball.—As many of the diseases of the orbit and to a considerable extent tumours of the eyeball itself, cause more or less protrusion of the globe, it will be well to say a few words on this subject before describing the morbid changes which may give rise to it.

The symptoms are obvious enough, and do not require description,

Causes.

The causes are the following:

1. Inflammation within the orbit, either with or without the formation of abscess.
2. Hæmorrhage into the orbit.
3. Vascular protrusion of the eyeball.
4. Exophthalmic goitre.
5. Tumours within the orbit, nodes, exostoses, malignant growths, cysts, nævi, &c.
6. Enlargement of the eyeball itself from (*a*) growths, malignant or simple; (*b*) inflammation and suppuration of the whole eyeball (ophthalmitis).
7. Paralysis of its muscles, allowing the globe to drop forwards, and thus assume an unusual prominence.

Double vision is *generally* complained of in protrusion of the eyeball.

Ill effects of protrusion.

The ill effects of the abnormal position are seen both in the globe itself and in the lids. Should the protrusion be so great that the lids cannot be closed over the eyeball the cornea will be left unprotected and may become opaque, and afterwards ulcerate or slough. If the protrusion continue for long the lids become distended and flaccid, their movements being much impaired; the tear puncta may also become displaced, giving rise to continual watering of the eye.

Treatment.—In all cases where the eyeball is healthy care should be taken to protect the cornea from injurious exposure by drawing the lids over it and keeping them fixed by a compress and bandage, but in extreme cases the edges of the lids must be pared, united by sutures, and allowed to heal firmly together. Closure of lids.

Inflammation within the orbit. Inflammation within the orbit.

Inflammation may affect the soft tissues within the orbit, the periosteum, or the bone itself; it may end in resolution, the parts returning to their natural condition; chronic thickening may result, causing more or less permanent protrusion and impairment of the movements of the eyeball; or abscess may form, and in the case of periostitis or ostitis caries and necrosis of the bony walls may supervene.

Symptoms.—Inflammation within the orbit is accompanied by more or less febrile disturbance, pain of a throbbing character much increased by pressure, swelling of the conjunctiva and lids, more or less prominence and impaired movement of the eyeball, intolerance of light, and watering of the eye; it may be the result of cold, injuries, or general diseases, as erysipelas, and (in the case of periostitis) of syphilis, or may come on in debilitated states of the system, during recovery from acute diseases (scarlet fever, measles, &c.), or from over-lactation. It is not easy to distinguish inflammation affecting the soft parts only from inflammation of the periosteum or bone. Symptoms. Causes.

Treatment should consist in allaying pain and inflammation by means of opium internally, fomentations of poppy-heads to the affected part, leeches to the corresponding temple (two to six in number), and rest in bed in a darkened room; any general medical treatment which may appear most applicable should also be employed. Treatment.

For instance, if the patient be strong and healthy, low diet, purgatives, &c, should be had recourse to; if weakly, as during recovery from some acute disease, tonics and good diet should be prescribed. Should the patient be the subject of syphilis this should be treated.

Should the inflammation go on to the formation of abscess, the symptoms are aggravated, the conjunctiva becomes more swollen, and in some cases almost covers the cornea, the lids are greatly swollen and red, the prominence and impairment of movement of the eyeball increase, and rigors may occur. Vision becomes misty, and in some cases all perception of light is entirely lost. After a time fluctuation may be detected; if left to itself, the abscess will burst, the pus being discharged either through the skin or conjunctiva. The abscess having been emptied, in favorable cases the swelling will disappear, the eyeball resume its natural position, and the opening heal. But in some cases, especially if the suppuration be associated with caries and necrosis of the bone, the abscess will remain open, or the orifice alone heal, the sac again becoming filled with pus. Abscess.

Treatment.—As soon as the surgeon feels satisfied of the existence of pus in the orbit it should be evacuated; if fluctuation can be detected the diagnosis is easy enough, but even if this cannot be done, and suppuration is suspected, an exploratory puncture should be made, when the escape of pus will clear up any doubt. Treatment.

The best method of opening an abscess in the orbit is that recommended by Mr. Hilton for evacuating pus situated at a depth from the surface amongst important structures. The operation should be per-

Hilton's method of opening abscess.

formed as follows:—An incision having been made, either through the skin or conjunctiva, at that part where the eyeball appears most thrust away from the wall of the orbit, a grooved director should be thrust in (the surgeon bearing in mind the direction of the wall along which he is passing the instrument and the depth of the orbit). As soon as pus is seen escaping along the groove of the director a pair of small dressing forceps should be passed along it until their points are within the abscess; the blades should then be separated slightly and drawn out whilst so separated; a ragged opening will thus be left, which is not likely to close too soon, and the danger of cutting important structures will be obviated.

The greatest care must always be taken not to injure the eyeball. As the operation is very painful, an anæsthetic should be given.

Immediately after the operation search should be made by means of a probe for diseased bone or foreign bodies; if a foreign body or loose sequestrum be detected it should be at once removed; diseased bone, if still firm, may be left to itself, and will either come away spontaneously or may require removal at a later period. If the opening appear inclined to close too soon it should be kept open by means of a piece of lint passed into it; only light water dressings need be applied.

Periostitis or ostitis.

Periostitis or ostitis followed by caries and necrosis of the walls of the orbit.

Symptoms.

SYMPTOMS.—The symptoms of periostitis or ostitis going on to caries or necrosis are similar to those above described, excepting, perhaps, that the pain is more severe and often aggravated at night. This form of inflammation should always be suspected in persons suffering from syphilis, and occasionally nodes may be met with at the margin of the orbit or on the forehead; their existence should always lead the surgeon to suspect that the inflammation within the orbit is periosteal. When the abscess has formed and burst, or has been opened, the seat of inflammation becomes evident from the character of the pus, which is of that peculiar unhealthy and bad-smelling variety met with in abscesses connected with diseased bone, as well as from the condition of the opening, which remains patent and is surrounded by large unhealthy granulations, and from the fact that the bare bone can be felt with a probe passed through the opening.

Terminations.

Caries and necrosis usually end in recovery after a time, the diseased bone being thrown off and the sinus becoming closed. The disease generally attacks the margin of the orbit and often leaves cicatrices, which cause great disfigurement and deformity of the eyelid. Should caries or necrosis occur deeply in the orbit the results may be most serious, the optic nerve becoming affected and vision lost, or the disease may spread to the interior of the skull, set up meningitis, and cause death.

Treatment.

TREATMENT.—In the earlier stages the treatment should be the same as that described under inflammation and abscess of the orbit, but when the abscess has burst, or been opened, its cavity should be syringed out daily with some mild disinfecting solution; care must be taken to prevent its too early closure, by means of a piece of lint pushed into the sinus; exuberant granulations should be kept down by the application of nitrate of silver, and distortion of the lids, if likely to occur,

must be prevented by uniting their edges (*see* Operations on the Eyelids).

If any pieces of bone are found loose they should be removed by operation. Removal of dead bone.

Hæmorrhage into the orbit.

Orbital hæmorrhage may depend upon the spontaneous rupture of a vessel within the orbit, and should it be considerable, may produce displacement of the eyeball. The blood may become diffused, and appear beneath the conjunctiva, being subsequently gradually removed by absorption; occasionally, however, the clot becomes encysted, and permanent displacement of the eyeball results. Hæmorrhage into the orbit also occurs in fracture of its walls frequently to a considerable extent; subconjunctival ecchymosis being a prominent symptom in some cases of fracture of the base of the skull extending through the roof of the orbit. Orbital hæmorrhage. Spontaneous. From injury.

Hæmorrhage sufficient to cause displacement of the eyeball has occurred after the operation for strabismus.

TREATMENT.—In cases of spontaneous hæmorrhage light pressure should be applied to the eye by a pad of lint or cotton wool and a bandage. Where excessive hæmorrhage occurs after operations for strabismus a large pad of lint should be placed on the closed lids, and firm pressure by means of a bandage kept up for a few hours after the operation. Hæmorrhage from fracture of the orbital walls is only of secondary importance to the injury which caused it, and may be left to itself; it is of more interest to the general surgeon than the specialist. Treatment.

Vascular protrusion of the eyeball. Vascular protrusion.

This is the name applied, and very justly, by Mr. Thomas Nunneley ('Medico-Chir. Trans.,' vol. xlviii) to a set of cases formerly considered to belong to the class of "aneurism by anastomosis," but which Mr. Nunneley shows differ in many essentials from the latter affection, both in their clinical aspect and history. He has also had opportunities of verifying his diagnosis by post-mortem examination, and in no case has he met with an instance of the above-mentioned affection due to this cause. Mr. Nunneley has reported in all seven cases, and mentions some ten or twelve others described by various writers. The cases reported are chiefly either instances of traumatic aneurism, or aneurism arising spontaneously from rupture of a diseased artery in an elderly person; but in one case a cancerous growth was found involving the orbit and other parts.

The symptoms complained of by the patient are, noise in the head and feeling of tension, singing in the ears, pain in the orbit and eyeball, all of which are aggravated by stooping or exertion, but are nevertheless most annoying at night. These symptoms are accompanied by more or less protrusion and impaired mobility of the eyeball, dimness of vision, much congestion, principally venous, of the eyelids and conjunctiva, and chemosis; pulsation (which may be controlled by pressure on the carotid of the same side) in any part of the orbit, and communicated to the eyeball, and often a bruit heard on auscultation over the brow or other parts immediately adjoining the orbit. Symptoms.

In most cases these symptoms have come on at a varying time, after some injury to the head, or have occurred spontaneously and suddenly.

Morbid changes.

The morbid changes met with in the three cases examined after death by Mr. Nunneley were in one (in which the disease commenced spontaneously, and the patient died sixteen days after ligature of the carotid) a dilatation of the carotid at the point of giving off the ophthalmic branch, the dilatation being filled with and surrounded by coagulum; the ophthalmic artery itself was somewhat dilated, its coats thickened, and atheromatous in parts; two of its branches were much dilated and filled with clot. In another case, also of spontaneous origin, a circumscribed aneurism of the ophthalmic artery, close to its origin, was discovered. The third case was found to be one of cancerous disease within the orbit, associated with cancerous tumours, in other parts of the body.

Cause of vascular protrusion of eyeball.

In the majority of cases of "vascular protrusion" of the eyeball the disease is not within the orbit, but intracranial, the protrusion being dependent on obstruction to the return of venous blood, and analogous to the swelling and congestion seen in the limbs when the main artery is affected by aneurism.

It is easy to understand how, in a small and firmly bounded space like the cavernous sinus, a very insignificant dilatation of the commencement of the ophthalmic artery, or of the carotid itself at any point within the sinus, or a small hæmorrhage from either, may prove a most serious impediment to the return of venous blood, much more so than the same amount of disease situated in the cavity of the orbit itself.

Nævus, as is well known, is not unfrequently met with in the orbit, but is, usually, easily enough diagnosed. (*See* p. 382.)

Case of traumatic aneurism.

A case of traumatic aneurism of the orbit, which is, I believe, unique, came under my observation in September, 1873.

The patient, a young gentleman, was, some two months previously, opening a hamper in which were some bottles of soda water; one of these burst, and a large piece of glass was driven with considerable force into the left orbit, inflicting a wound in the upper eyelid, just external to the internal angular process of the frontal bone; the glass dropped out; sharp arterial hæmorrhage occurred, which was stopped by pressure; much swelling and ecchymosis of the lids followed. The wound healed, the swelling and ecchymosis disappeared, and all appeared to be going on well, but shortly before being seen by me the eyeball seemed to be somewhat protruded, and considerable congestion of the eyelids and conjunctiva was noticed. When first seen by me there was much venous congestion of the eyelids and conjunctiva (no chemosis), marked protrusion of the eyeball in a direction somewhat outwards; a small pulsating tumour could be distinctly felt near the inner angle of the orbit; a marked thrill was communicated to the eyeball, which could be felt on placing the hand upon the closed lids; a buzzing in the head was complained of, especially on stooping; there was a small linear cicatrix over the pulsating tumour, marking the seat of the original injury.

Ophthalmoscopic examination showed an extremely dilated and tortuous condition of the retinal veins, but detected no pulsation; there was no impairment of vision.

Effect of pressure on carotid.

Pressure on the left carotid at once stopped the pulsation, and caused considerable decrease of the venous congestion.

Aneurismal varix was diagnosed. Perfect rest and pressure applied

directly to the part were tried for some months without benefit. It was at length determined by the patient's medical attendant to perform an operation; accordingly, an incision was made over the tumour, and several fair-sized vessels which appeared to communicate with it were tied; the wound healed kindly. Cure by operation.

I saw the patient again at the beginning of the summer of 1874. The congestion had disappeared, the pulsation ceased, and the eyeball had returned to its natural position, the only sign of the disease remaining being a small linear cicatrix in the upper eyelid and a slight thickening near the inner angle of the orbit in the position previously occupied by the pulsating tumour.

TREATMENT.—Rest, low diet, with depressing remedies, as cold applied locally, and the administration of digitalis or antimony, should always have a fair trial. Pressure applied locally, by means of a pad and bandage, should also be employed if it can be borne. Treatment.

These means failing, recourse must be had to digital pressure of the carotid, kept up for some hours, the patient being under the influence of an anæsthetic, as pressure in the neck gives rise to such intolerable pain, that even the most resolute can only bear it for a few minutes at a time. Digital pressure.

As a last resource, a ligature must be applied to the common carotid on the same side as the disease. Ligature of common carotid.

This operation was performed in all but one of Mr. Nunneley's cases with the best results.

Should a case similar to that reported in this article occur, the operation which proved so successful in it should be performed.

Exophthalmic Goitre (Basedow's Disease).

Exophthalmic goitre.

This disease is characterised by protrusion of the eyeball, impairment of the movements of the lids, and diminished sensibility of the cornea and conjunctiva, accompanied by disturbance of the heart's action and systolic murmurs in the heart and great blood-vessels of the neck together with dyspnœa and enlargement of the thyroid body.

TREATMENT.—Should the protrusion of the eyeballs be very extreme, ulceration and perforation of the cornea may occur; this may be guarded against by protecting the cornea with a small pad and light bandage applied over the closed lids, or the palpebral aperture may be closed by operation. These patients are, however, extremely intolerant of anæsthetics. General medical treatment should also be employed; for this the reader is referred to works on general medicine.

Tumours of the Orbit, Orbit and Eyeball, and Eyeball alone.

Tumours, &c.

Tumours of the orbit alone are—exostoses, nævi, cysts, nodes, and malignant growths. Those of both orbit and eyeball are usually malignant, and commence primarily either in the eyeball or some of the other structures within the orbit. Those of the eyeball alone are also for the most part malignant, but simple sarcomatous and cystic growths are occasionally met with.

Tumours of the Orbit alone.

Exostoses.—These are of two kinds, either hard, ivory-like masses, consisting of compact bony tissue; or soft spongy growths, of an open cancellated structure. Exostoses.

Bony tumours are generally met with as hard, more or less circumscribed outgrowths of varying size, growing either from the bone itself or from the periosteum. They affect the orbit alone, or may project into neighbouring cavities, a fact which should be borne in mind when attempting their removal.

Treatment. TREATMENT.—Should exostosis of the orbit give rise to inconvenience, it may be removed by operation. An incision should be made, parallel with the margin of the orbit, over the most prominent part of the growth, which, having been thoroughly exposed, should be removed in any way which may appear the most effectual, the greatest care being taken to guard the eyeball from injury, and, if possible, to preserve the continuity of the lachrymal canaliculi and position of the tear puncta. In the removal of the hard ivory exostosis the greatest difficulty will be experienced, some hours' patient work with chisel and mallet being occasionally required. The surgeon who undertakes the removal of such a growth should be aware of the extreme difficulty to be surmounted, and arm himself with a corresponding amount of patience and perseverance before commencing the operation.

Ivory exostosis.

Spongy exostosis. The soft, spongy growths are much more easily removed; the tumour, having been thoroughly exposed, can usually be broken off with strong forceps. Should the growth be on the inner side of the orbit, and much force be used in its removal, the cavity of the nose may be opened and the operator may be rather alarmed at seeing large quantities of air blown out with the blood. This accident, however, need occasion no uneasiness, as it makes no difference to the progress of the case; nevertheless, care should always be taken not to fracture the orbital walls; should the fracture take place in the roof, instead of the inner wall, the consequences would be most disastrous, as the cavity of the cranium would be opened.

Fracture of orbital wall during removal.

Nævus. Nævi are not uncommonly met with in or about the orbit, situated generally near its margin, or in the eyelids, but sometimes growing deeply in the orbital cavity. They present much the same characters as in other situations, being soft to the touch, of a bluish colour, and becoming harder and more tense during crying or straining.

Treatment. TREATMENT.—Subcutaneous ligature is most applicable in some cases, but care should be taken to prevent as much as possible subsequent cicatrisation, in consequence of the deformity it may produce in or about the eyelids. Other cases may be treated by setting up adhesive inflammation within the growth, by the use of the galvanic cautery, or by passing a number of small setons soaked in perchloride of iron through its substance. The setons should be left in until they have set up a slight amount of suppuration. Injection of the growth with perchloride of iron, solution of tannin, or chloride of zinc, may also be tried, but the greatest caution is necessary, as the operation has occasionally been followed by the sudden death of the patient.

Cysts. Cysts.—Various kinds of cysts are met with in and about the orbit, the most common being the congenital dermoid cyst (*see* Operations on the Eyelids). Simple cysts, probably the remains of hæmorrhages, and cysts connected with the lachrymal gland, are also met with. Hydatids have occasionally been seen.

Nodes. Nodes.—Periosteal nodes are not unfrequently met with; they occur as hard and sometimes painful tumours, usually situated somewhere about the margin of the orbit, but sometimes deep in its

cavity. The existence of a node deep in the orbit should always be suspected in cases of paralysis of any of the ocular muscles, displacement of the eyeball, &c., if these symptoms be associated with nodes on the forehead or margin of the orbit and other symptoms of syphilis. Nodes gradually disappear under anti-syphilitic treatment.

SARCOMATOUS OR CANCEROUS GROWTH may be met with, and when possible they should be removed by operation.

Tumours of Orbit and Eyeball.

Tumours of orbit and eyeball.

The tumours affecting the orbit and eyeball are malignant growths which have usually commenced within the eyeball and afterwards perforated the tunics and implicated the tissues of the orbit. They are generally of the variety known as melanotic sarcoma.

Melanotic cancer.

The appearance of the tumour varies according to the stage of growth at which it has arrived. In an advanced case a large fungoid mass of a dirty greyish or brownish colour, having a foul surface covered in parts with dark scabs, in others discharging thin unhealthy matter occasionally mixed with blood, will be seen protruding between the swollen and distended lids. On closer examination the eyeball (as such) will be found nearly destroyed, portions of the sclerotic alone remaining in their proper position. The movements of the globe are much impaired, or altogether wanting, the growth having implicated the whole of the tissues of the orbit in one malignant mass. It is curious how the growth as it advances beyond the limits of the eyeball loses its melanotic character and becomes light coloured.

Constitutional disturbance.

The constitutional disturbance in these cases is often severe, especially when the disease is far advanced.

Treatment.

TREATMENT.—The treatment of these growths depends much on the extent to which the tissues of the orbit are implicated and the state of the patient's health.

If the tumour is fairly circumscribed, so that there appears to be a reasonable hope of removing the whole, and the patient is in such a state of health as to preclude the likelihood of similar deposits in other parts, extirpation of the eyeball and other diseased tissues should be performed, any portions of growth that may be left being afterwards destroyed by some escharotic, But should the orbit be so filled by cancerous deposit that there appears to be little hope of removing the whole growth, more especially if the patient is in a cachectic condition, no operation should be thought of, and the surgeon must content himself with palliative treatment, as opiates to relieve pain, and attention to the general health.

Tumours of the Eyeball.

Tumours of the eyeball.

(1) Glioma.
(2) Sarcomata, melanotic, round, and spindle-celled.
(3) Carcinoma.
(4) Strumous deposit.

Glioma is most commonly met with in children, but occasionally in older persons.

Sarcomata, melanotic, round, or spindle-celled, are usually met with in persons of from fifty to sixty years old, and occasionally in early adult life. The melanotic is the most common form.

Carcinoma has been met with in persons past the middle period of life, but its occurrence is rare.

Glioma.

Glioma commences in the retina; it presents the following appearance:—Should the patient be a child, it will generally be healthy looking and present no signs of cachexia; attention has been drawn to the eye from a peculiar glistening appearance of the pupil (cat's eye). On examination the surgeon will notice the peculiar reflection through the pupil, which is generally somewhat dilated but movable in the earlier stages. Examination, both by means of the ophthalmoscope and by lateral illumination, will show a whitish growth projecting into the vitreous chamber, either as a single prominence or in nodules; the growth will gradually increase, its surface become covered with blood-vessels, the retina be displaced, and sight soon entirely lost.

Progress of disease.

As the disease progresses the tension of the globe increases, the pupil becomes widely dilated and fixed, the iris pushed forwards and nearly in contact with the cornea, and the lens opaque, preventing a view of the interior of the eye; the whole globe now gradually enlarges, frequent inflammatory attacks occur, the sclerotic becomes thinned, and at last, if the growth is allowed to remain, a slough forms near the centre of the cornea, which ruptures, and a fungoid bleeding mass protrudes.

Rupture of the cornea.

The increase of the growth now becomes much more rapid, and it may grow to a considerable size in a short time.

As soon as the growth becomes exposed to the air it commences to discharge thin sanious pus and blood, and becomes more or less coated with a dirty yellow scab. The eyelids become inflamed and swollen, sharp attacks of hæmorrhage may take place, the general health suffers, and the patient dies from exhaustion or from extension of the disease to the brain.

Glioma in its earlier stages is likely to be confounded with scrofulous deposit within the eyeball, but it is not likely to be thus mistaken after perforation has occurred.

Treatment.

TREATMENT.—The only treatment of glioma is extirpation of the globe, and this should be done as soon as the nature of the disease has been made out; but however early the operation may be performed, the disease is almost certain to return, either in the optic nerve or brain.

Sarcomata.

Melanotic sarcoma, or black cancer, affects persons of advanced age; it is a variety of soft cancer, characterised by the development of black pigment-cells; it may grow either from the interior or exterior of the eyeball, but generally commences in the choroid. It is said not to be so liable to recur as glioma. Round- and spindle-celled sarcomata also commence most commonly in the choroid.

Treatment.

TREATMENT.—Early extirpation. In all cases of excision for malignant growths, the optic nerve must be cut as far back as possible.

Carcinoma, as above stated, is rarely met with.

Strumous deposit.

Strumous deposit.—The appearance of this deposit within the eyeball closely resembles that met with in the early stages of glioma. The patients are usually children. There is the peculiar glistening appearance of the pupil noticed in glioma, and blood-vessels are seen upon the surface of the growth; the retina is more or less displaced by fluid between it and the choroid, and floats in the vitreous chamber. The growth goes on increasing, the pupil becomes dilated, its mobility is destroyed; the lens becomes opaque, the sclerotic thinned, the whole eyeball somewhat enlarged, and suppuration may occur; supposing the disease to have gone on up to this point, there is nothing by which it can be distinguished from glioma.

Now, however, the difference becomes manifest; the growth, instead of increasing, destroying the cornea, and projecting from the eyeball, commences to shrink, and with it the eyeball, which becomes soft, and is at length reduced to a small irregular mass. The growth of strumous deposit may become arrested at any time, and the shrinking of the eyeball commence; in this, again, it differs from glioma. Diagnosis.

Treatment.—Should there be much pain, the eyeball must be removed, otherwise tonics and good generous diet will suffice. Treatment.

Inflammation and Suppuration of the Eyeball (Ophthalmitis).

Ophthalmitis is usually the result of injuries, especially of those complicated by the lodgment of a foreign body within the globe; it unfortunately not unfrequently follows operations for cataract, and is occasionally met with during erysipelas, pyæmia, scarlet fever, &c., and sometimes in women after confinement, especially if the strength is lowered by over-lactation. The disease may begin in any of the structures of the eyeball. Should it commence in the cornea and iris, the former will become cloudy, and soon abscesses will form in its substance, the iris likewise becoming discoloured and covered with pus. The suppuration may stop short here, the cornea and iris being alone destroyed, and the eyeball left with some perception of light (*see* Suppuration of Cornea and Iris). Should the disease, however, commence in the deeper structures of the eyeball, rapid impairment of vision will take place, all perception of light being lost in perhaps a few hours. Ophthalmitis.

If the pupil be clear, pus may be seen behind it, but in most cases all appears dark; the movements of the eyeball are much impaired, and the lids and conjunctiva considerably swollen. As the disease advances the eyeball becomes enlarged and its tension increased, and if left to itself will rupture and discharge its contents much to the patient's relief. The globe afterwards shrinks to a small button-like stump. Pain is very severe in many cases, but occasionally is altogether wanting. Suppuration of the eyeball rarely sets up sympathetic changes in the fellow eye. Rupture of globe.

Treatment.—This depends upon the cause of the disease, and whether one or both eyes are affected. Should the inflammation depend upon the lodgment of a foreign body, this should be removed without any reference to its position or the state of vision; if the eye have still good perception of light it will certainly be destroyed, and whatever difficulties the surgeon may encounter he cannot possibly make matters worse, and he should not hesitate an instant, or he will lose his chance of preserving any sight that may be left. Any foreign body having been removed, the surgeon's next care should be to relieve pain, and, if possible, check the progress of the inflammation. Treatment. Removal of foreign body.

These indications are best carried out by the application of leeches (if the patient be strong, and can bear bloodletting), by opium internally, and by the constant use of sedative fomentations; the best being the Fotus Belladonnæ (made by dissolving a drachm of extract of belladonna in a pint of warm water) mixed with an equal quantity of Fotus Papaveris (made by boiling an ounce of poppy-heads in a pint of water); a piece of rag or lint soaked in this mixture as hot as it can be borne should be kept constantly applied to the affected eye. Poultices may also be employed. Most patients will require the administration of a fair amount of stimulant, good food, with iron and quinine. Fomentations.

When suppuration has been fairly established, and all perception of light lost, the eyeball must be treated as an ordinary abscess and the pus let out by incision.

Incision.

CHAPTER IX.

AFFECTIONS OF THE EAR.

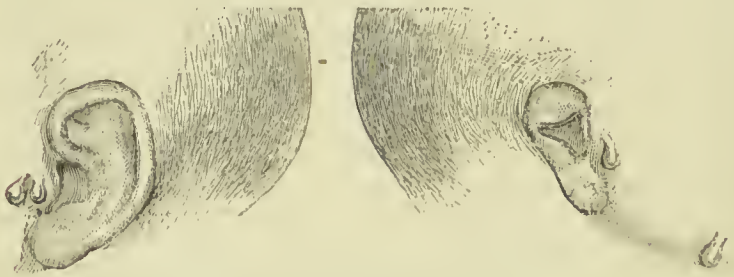
By Mr. Laidlaw Purves.

AFFECTIONS OF THE EXTERNAL EAR.

Malformations.

Malformations.—The malformations of the external ear which are met with are very varied, extending from cases in which there occur an entire want of the auricle to those in which the possession of a double set is seen. In cases where the hearing is not affected by the malformation the surgeon may be consulted as to the propriety of an operation with a cosmetic view. He must in these regulate his opinion by the usual surgical rules, having regard to any possible interference with the acuteness of hearing which an operation might entail. The most common malformation is a congenital, either partial or entire, want of the auricle, with a failure of the meatus auditorius externus, or an occluded meatus, the lobules of the ear occasionally being displaced either on to the neck or cheeks (*vide* Fig. 107). But the

Fig. 107.



Drawing of occluded ears taken from a female patient of Mr. Bryant's, aged three months. Right auricle smaller than left and more deformed. The pendulous bodies contained cartilage, the child had likewise a pendulous outgrowth on left nostril.

auricle may be absent from injuries, and the meatus closed from otitis, lupus, &c. Such defects do not necessarily occasion an absence of the hearing power, and cases are on record in which patients with this defect could hear sufficiently well to hold conversations with those to whose voices they were accustomed. Before deciding to operate in such congenital cases it is advisable to keep the child under observation for some time for the purpose of noting if any signs of hearing are developed. Should it be determined to operate, the point of operation may now and again be fixed by passing a current of air through the Eustachian tube and noting the point at which the impingement of air at the end of the cul-de-sac is heard best. This is accomplished by using what is generally called "Politzer's method" (Fig. 108), which consists in passing the soft nozzle of a caoutchouc bag filled with air into one or other nostril of the patient, and while he swallows a mouthful of water, compressing the nostrils with the fingers of the left hand so as to prevent the exit of air through

Treatment.

them. At the same moment the right hand forcibly expels the air from the bag in such a way that, finding no passage open except the Eustachian tubes, it rushes up them, passes into the tympanic cavity, and pushes out the membrana tympani. It is this sudden rush of air against the external wall of the cavity which the surgeon listens for by means of a tube of india rubber, passing from the meatus of the patient to that of the surgeon. In cases of absence of the meatus a stethoscope may be used, by which the surgeon determines at which point the air impinges most forcibly, and at this point he makes his opening. If hard and bony at this spot, the trephine will be necessary, if soft, the knife will suffice, making a crucial opening and keeping the opening patent by means of tents or other foreign bodies. In congenital cases the opening ought to be made very carefully, watching for the membrana tympani; but should there be no membrane found on cutting down to the usual position of such it is advisable to allow the artificial opening to close again. If the deafness before operating is very great it is probably better to discountenance any operation, as the results of interference with congenital malformations of the ear have generally been by no means satisfactory.

Fig. 108.



Politzer's method of inflating the middle ear.

Cutaneous affections of the external ear.—Hypertrophy from chronic inflammation, eczema (acute and chronic), herpes, impetigo, pemphigus, erysipelas, affect the auricle, and have much the same appearances, follow the same courses, and are amenable to the same treatment as in other parts of the body. Particular attention ought to to be paid to any skin affection which may be present in the neighbourhood of the auricle, especially in the hair, careful note being paid to the sort of pomade or other application the patient uses for cosmetic purposes. The meatus auditorius externus ought to be cleared once daily by a lukewarm water injection of any collection of epidermis or cerumen which is apt to be of a greater quantity than normal during the progress of the skin affection.

Cutaneous affections.

Treatment.

Fig. 109.



Injuries.

Injuries to the external ear.

Injuries to the external ear are by no means rare, but, happily, if confined to the auricle, they affect the hearing of the sufferer but slightly. Under the usual treatment they generally do well, care being had to make as perfect an adjustment of the parts as possible. In 1866 Mr. Bryant treated a girl of twelve years of age for the effects of an

Drawing 22439½

ulceration of the external ear some years previously. The condition of the ear is indicated in the accompanying engraving (Fig. 109). By paring the edges of the pendulous portions of the auricle, and the skin covering over the parts behind, a good-looking entire ear was made with great addition to her comfort.

Tumours of auricle.

The tumours of which the auricle may be the seat are the othæmatous, gouty, fibro-plastic, fibro-cartilaginous, sebaceous, erectile, epitheliomatous, and sarcomatous. The fibro-plastic or cheloid has been already alluded to as occurring in the lobulus of the ear after the operation of puncture. I have seen many such, the largest having been the size of a walnut (Fig. 110). They generally do well after excision, but if not thoroughly removed will grow again. The othæmatomatous requires special mention, but the others are to be recognised and treated as in other parts of the body.

Report by Dr. Goodhart on Cheloid Tumours of the Ear.

Cheloid tumours.

The small tumours or thickenings of the skin which usually go by the name of cheloid (Alibert) are of inflammatory nature, with more or less

Fig. 110.



Cheloid tumour of ear. Fig. 111 gives the microscopical appearances of one of those cheloid tumours from the pencil of Dr. Goodhart

Fig. 111.



tendency to become fibrous.

These drawings, made from a section of one of these growths in the lobule of an ear which had been pierced for an earring, show the microscopical characteristics. Its macroscopical appearance was that

of a fibrous tumour. It will be seen that, in addition to newly formed fibrous tissue, there is also a great deal of nuclear germination going on.

Hæmatoma.

Idiopathic hæmatoma auris, or vascular tumour of the ear, consists, according to the latest trustworthy authorities, of a degenerative morbid process induced by general disturbances of nutrition. The cartilage of the auricle is its seat, but the pathological appearances differ, as some have found the perichondrium separated from the cartilage, while others have found "pieces of the cartilage attached to the perichondrium." In other cases the cartilage has been found thicker but no harder than natural, the thickened part presenting no appearance of a cyst, but under the microscope showing hypertrophied cartilage-cells and intercellular matter. This idiopathic hæmatoma commences by a flushing of the auricle, which becomes hot and painful. In a few hours an effusion of blood takes place, which, generally commencing in the concha, gradually spreads over the auricle, feeling firm to the touch, but allowing of fluctuation being detected if looked for with care. It is believed to be peculiar to patients suffering from different forms of insanity, general paralysis having the largest share, melancholia, acute and chronic mania and dementia, following in the order named. Dr. Hun thinks that the affection obtains such an exclusive position amongst the insane that he holds that any one suffering from hæmatoma auris, although sane at the time of observation, ought to be suspected of insanity.

Fig. 112.



Hæmatoma auris.

That the affection occurs in persons who have no hereditary history and show no symptoms of insanity is undoubted, but whether the pathological changes at the seat of the tumour are the same in those cases or differ in the other cases in which there is a history of traumatic injury is yet undetermined, though I am inclined to believe from the cases which have come under my own notice that those resulting from injury do not arise from the same pathological changes.

Treatment of hæmatoma.

The modes of treatment recommended by different authorities vary. Gruber recommends evacuation of the fluid and coagula and the after-use of a compress bandage, while Wendt relates a case where vascular tumour recurred twice after incision, but passed off under lead-water applications and compression. I have tried the different methods proposed, once passing a seton through the tumour, and keeping up a slight discharge from it, and find them get well under all the different methods. Since the application of astringent lotions and a compress is less alarming to the patient, and seems as effectual, I am inclined to follow it in future cases, keeping up the compression by a modified letter clip applied to the ear, padding the arms of the clip so as to prevent injury to the skin of the auricle.

Affections of the external meatus.

Affections of meatus.

Ear speculum.

To examine the external meatus it is usually necessary to employ a speculum for the purpose of straightening and widening the canal, and so allowing of the passage of rays from a natural or artificial light. The specula are formed of silver or caoutchouc

and are of various forms. The silver speculum of Wilde, with a round aperture at the narrow end, will be found as convenient as any, it being necessary to have three or four different sizes. If available, sunlight, either direct or reflected from a white cloud, is, I think, the best mode of illumination, as it gives the different tints of the meatus and tympanic membrane more truly than any artificial light. Seating the patient near a window, with the ear to be examined away from the window, you receive the rays on a mirror either held in the hand or placed on the forehead, and reflect them into the meatus by inclining the mirror to the required angle. If you use the rays direct from the sun itself it is necessary that a plane mirror should be used, the usual concave mirror soon causing such an amount of heat to be felt at the spot on which the reflected rays are thrown that the patient cannot endure a long examination. Should sufficient daylight not be obtainable, an argand burner, with or without a bull's-eye lantern placed over it, will act as a good substitute. Having arranged your flood of light so that it falls on the auricle and external meatus, you take the superior and posterior part of the auricle between the middle and index fingers of the left hand, and, pulling the auricle backwards and upwards, you widen more fully the lumen of the meatus, into which you introduce by the right hand the small round end of the speculum. Passing it gently in by a slightly rotating motion, you reach a spot where, there being no foreign body to occlude the view, if the meatus is of a normal width the tympanic membrane will be exposed to view. On accomplishing this, the external edge of the speculum is passed to the care of the thumb and index fingers of the left hand, which move it in different directions so as to throw rays on the different portions of the canal and the tympanic membrane, while the right hand is left free to use the mirror, or, placing the mirror on the forehead, to use any instruments which may be necessary.

How to examine ear.

The most frequent change in the external meatus which comes before the surgeon on thus looking into the canal is an accumulation of cerumen, known by its position, form, colour, and light reflection. It occurs on account of some hyperæmia of the ear, of which a very common cause is the irritation arising from scratching the meatus with pencils, pins, &c.; but anything which causes an increased flow of blood to the lining membrane of the meatus will cause a greater accumulation of cerumen than normal. It also occurs in those much exposed to the sun and dust, in those who perspire freely, and in the old, in whom the cerumen is denser and stiffer than in the young.

Cerumen.

The subjective symptoms caused by such accumulations are pain, vertigo, confusion of ideas, tinnitus aurium, and deafness, the latter symptom being often characterised by its sudden entrance and departure.

Symptoms.

The prognosis is not so favorable as is generally supposed. If a vibrating tuning-fork placed on one of the incisors or on the middle line of the vertex is not heard better, or so well, in the affected ear as in the non-affected, you may expect some complication, and the mere removal of the cerumen will not probably be followed by much beneficial result to the deafness. Toynbee gives, as the results of his removal of accumulations of cerumen from the meatus causing deafness, a table of 165 cases, of which 60 were cured, 43 were improved, and the remaining 62 were "either but slightly or not at all improved."

Prognosis.

Mr. Hinton gives one in six as his proportions of recovery in the same. It will thus be seen that in a large proportion of cases of accumulation of cerumen in the external auditory meatus there is a complication present which does not give way on the removal of the cerumen, and which clouds the prognosis considerably.

If you can easily lay hold of the accumulation by means of the forceps without risk of pushing it against the membrane, and without causing pain, it is well to remove it in that way, especially if you are removing it for the purpose of obtaining a view of the parts behind which you wish to examine on account of some affection present, as, should there be some abnormality of the parts behind, the passage of a strong current of water might prejudice them. But should it not be practicable to remove the accumulation by the forceps without causing irritation, the syringe must be used in the manner described in treating of foreign bodies in the meatus. Treatment.

A lessening of the secretion is sometimes seen in acute affections of the middle ear, and in nervous deafness, but, before making your diagnosis in such, inquiry of the patient as to what he has done to the ear before coming to you is useful in eliciting a good reason for the condition found. The use of some slight emollient and attention to the primary cause, if any such is detected, comprises the treatment.

Foreign bodies.

Foreign bodies.

In no department of surgery is the aphorism that "blind zeal only hurts" more necessary to be remembered than in that relating to foreign bodies in the ear. The form of the canal is so peculiar, being that of a spiral turning anteriorly inwards and downwards, and having expansions at either extremity, and the forms of the foreign bodies which enter or are placed in the meatus are so varied, that the efforts to remove them by any other means than a current of water must be used only where the practitioner is guided by an accurate knowledge of the anatomy of the external meatus, if damage to the delicate structures which limit the inner end of the meatus is to be avoided. So common are forcible attempts to extract by those unaccustomed to meet such cases, that it is exceptional that a case is seen by the surgeon before such efforts have been made as have caused a certain amount of inflammation of the canal and its consequent lessening in caliber. In such, where the caliber has been rendered too narrow to admit of the passage of the foreign body without considerable force, the first indication is to allay the inflammation by rest, leeches, and fomentations. The exudation having been absorbed, and the canal having nearly or wholly resumed its normal size, the surgeon ought to determine whether there is a foreign body present, and, if possible, its size, form, and position, for cases continually occur in which a patient suffering from chronic disease of the middle ear has the feeling of a foreign body being present, while others are either the subjects of delusion from other causes, or are attempting to delude you. This information is obtained by means of the usual mirror, speculum, and probe, by the last of which you can determine if the body is hard or soft or moves easily. If the last is the case you may, by inclining the head to the side of the ear affected, shake it out, or by laying the one hand on the ear a sharp percussion on the hand so placed may remove it. But the persevering use of an injection of lukewarm water from a four- or five-ounce syringe, the point of the nozzle of which has a caliber of from one to two milli- Treatment.

mètres, is the method which ought to be used above all others, which carries with it the least danger, and is by far the most successful. A bowl being held by the patient so that the rim is pressed against the skin close under the lobule of the ear, the surgeon draws the auricle upwards and backwards so as to straighten the external meatus, and the nozzle being passed slightly within the external opening and pressed against the upper wall, a moderately forcible current is made to pass along the upper wall, sweep across the membrana tympani, and by it is directed outwards, in which latter course it meets with the foreign body, and, carrying it with it, forces it along the lower wall of the canal and out at the external opening. It may be necessary to change the position of the patient's head so as to give the stream a different direction, according to the position of the foreign body in the canal, the endeavour being always to pass the inward current beyond the body, which ought to be influenced only by the outward rush. Should the body be impacted it may be necessary to loosen it by the probe before you can remove it by the syringe, but the first injections generally suffice to do this. This failing, which is extremely rare, and the body being soft, you may pass a hook into it from the side and so extract it; or should it be too large for this you may, having fixed it with the hook so as to prevent it passing further in by your manipulations, pull pieces out of it by means of small kneed forceps and so reduce its bulk sufficiently to extract by the hook. When the body is hard and so formed that the current cannot have much influence upon it, and a hold by forceps or hook cannot be obtained, Lowenberg's method of bringing the point of a camel's-hair pencil armed with joiners' glue or other glutinous material into contact with the body, allowing the viscous substance to harden and thus binding the pencil and the foreign body together and so extracting them, is sometimes useful. Many other instruments have been proposed to remove foreign bodies, most of which are not worthy of a place in the surgeon's armamentarium, but mention must be made of Wilde's wire snare, which may be found very useful and has the advantage of being very safe, and Mr. Durham's ear forceps, which allows of the passage of the instrument through a narrow speculum—a very great desideratum.

When impacted.

Fig. 113.



Syringing ear.

It may happen that none of the above-mentioned means will enable you to extract the body, and yet the symptoms of pressure on the nervous structures—giddiness, confusion, delirium, &c.—are so urgent that removal is imperative. In such you may be compelled to place the patient under chloroform, enter the meatus by loosening the auricle from its superior attachments, or through the mastoid process, and so

reach the offending body and extract. But resort to such serious measures will only be called for by the most pressing symptoms, and then probably in cases where violent unsuccessful efforts to extract have been made, *as the mere presence of a foreign body in the external meatus rarely causes much pain or annoyance.*

Before attempting to remove certain bodies it is necessary to place them in a condition favorable to their removal or to allay the unbearable irritation caused by some of them. For example, a ball of cerumen may be so hard that no instrument will pierce it sufficiently to give the surgeon sufficient purchase upon it to extract it, or it may be too large to pass the isthmus of the external meatus without the use of undue force. In such you are compelled to soften it by repeated soakings in hot water or a solution of glycerine, or some alkaline solution, before endeavouring to break it up. Again, when some small animal has passed into the ear and its movements are causing great annoyance by irritating the excessively sensitive tympanic membrane, it is necessary to introduce tobacco smoke or water, or a little spirit and water, or oil, to kill it, and at once allay the irritation before attempts at removal are undertaken. Modes of softening foreign bodies.

Maggots are sometimes found in the external meatus and tympanic cavity, especially in cases of otorrhœa, and are generally difficult to remove. Should the membrane not be perforated the syringe will suffice, but, as in the cases in which they are mostly found the membrane is perforated, the forceps is found more effectual. To allay the pain generally occasioned by their presence the injection of ten drops three or four times daily of a lukewarm solution of a grain of acetate of lead and a grain of acetate of morphia in an ounce of water, will be found of service. Various kinds of aspergilli are met with, especially in climates warmer than that of England; but even in England they are more common than is generally believed, judging from the cases reported in the medical journals as rarities and worthy of notice. The appearance on examining the meatus with the speculum is as if fine meal had been blown into the ear, or as if "coal dust had been blown on to white sand." The true diagnosis can be made certain by the microscope only. The parasiticides proposed are many, but warm water often used or a mixture of spirit and water will suffice in all cases.

Should it be found after the removal of any foreign body that the tympanic membrane has changed its position, and does not of itself recover its normal situation, the air-bag or catheter or the vacuum speculum may be of benefit in assisting you to replace it.

A piece of wadding should be lightly inserted in the meatus after the removal of the foreign body, and kept there for some hours, so as to protect the irritated parts from cold, strong noises, &c.

It ought to be remembered that foreign bodies in the ear may cause many reflex actions, such as tickling in the throat, giddiness, pain and heaviness in the head, vomiting, cough and expectoration, sneezing, anæsthesia of side, epilepsy, &c.

Furuncles of the external meatus originate generally in one of the hair-follicles or in one of the ceruminous glands. They occur mostly as the symptom of some constitutional affection, in which case they are associated with boils on other parts, or of some deeper local chronic inflammatory lesion, and are considered in such as a favorable sign. Furuncles.

The long-continued use of astringent lotions, especially of alum solutions, seems to place the meatus in a condition favorable to their formation, if it be not the actual cause in some cases. The symptoms they occasion are great throbbing and pain, consequent on the unyielding condition of the skin and connective tissue of the external meatus to the pressure from the accumulating pus, fever (especially during the evening), sometimes tinnitus, a feeling of tension in the ear, and more or less deafness, according to the position and extent of the inflammation. They occur at all ages and in all constitutions, but middle age obtains by far the majority of cases. The prognosis is favorable, though you may be unable to check the formation of new crops, which go on for months, even in the most robust people.

Treatment. The treatment is conducted either with a view to arrest the development of the abscess, or the formation being complete to give the pus free exit. The former may be brought about by painting the swelling with a strong solution of nitrate of silver (ʒss—ʒj to ℥j of water) or a solution of sulphate of zinc of the same strength. The latter is best accomplished by a small narrow knife, so narrow in the blade and handle that it does not exclude your view of the part while making a free incision through the boil. After making the incision I find it useful to apply a vacuum speculum (Siègle's—*see* article on Affections of the Membrana Tympani) to the meatus, and by suction empty the abscess as much as possible of pus and at the same time obtain a free flow of blood from the wound. The application of moist heat afterwards by frequently filling the ear with warm water, and laying for half an hour or so a cataplasm over the whole ear so filled, of leeches in front of the tragus if there is much pain, or of a plug of cotton which has been saturated with glycerine (Fisher), changed twice daily, for the same purpose, and the judicious use of purgatives, result in a favorable termination to the particular boil in question, but the constitutional treatment must follow to prevent, if possible, the development of others. As a local preventive, Mr. Hinton considered that the application to the meatus of red or white precipitate ointment was of service.

Narrowing of meatus. **Narrowing of the meatus** in the cartilaginous portion occurs not unfrequently in the aged, on account of the tense tissue-bundles of the posterior and upper walls having become loosened and sunk forwards against the anterior wall. This narrowing seldom leads to complete closure, and therefore does not influence the hearing power to any extent, but its presence prevents the normal exit of the cerumen, and so tends to the formation of cerumen balls beyond the narrowed part of the meatus and their results. Other narrowings, besides those which are congenital, arise from thickening of the skin after frequent attacks of inflammation of the meatus, after furuncle and other tumours, eczema, and the long use of astringent lotions or ointments. Except in the case of tumours, you may widen the canal by the use of the *Laminaria digitata* or sponge dilators sufficiently to form your diagnosis and apply remedies.

Treatment. Treat any affection of the tympanic cavity which may be present. Keep the canal clear of cerumen and epidermis by injections of lukewarm water or the passage of a dry camel's hair pencil, and by the use of small ivory bougies, gradually increased in size so that the amount of pressure may be kept up, promote absorption.

Exostoses. **Exostoses of the meatus** are found in individuals of the gouty, rheu-

matic, and syphilitic diatheses, though their connection with this last diathesis is not well established. They are certainly frequent in the meatus of good livers, who are likely to have their mucous membranes frequently congested. On looking into the meatus an elevation is seen, generally about the middle third, the skin over which is reddened and moist, and pressure on which by the sound causes pain.

Treatment. The treatment is not satisfactory, unless the exostosis has a pedicle, in which case it may be broken off. In other cases, having paid attention to any affection causing congestion of the mucous membrane of the tympanic cavity, the application of iodine to the growth itself, and behind the ear, so as to keep up a slight counter-irritation for a lengthened time, and the exhibition of it internally, offer the best hopes of resolution. Should, however, the exostosis prevent the exit of pus from the parts internal to it, the formation of a channel by a hammer and chisel, trephine, dentists' drill, or electrolysis, and the maintaining of it by tents, may be imperative for the purpose of keeping the parts clean and the application of medicaments to the parts beyond.

Hyperostosis. **Hyperostosis of the bony meatus** is seen after a chronic otorrhœa and generally extends through the whole of the bony canal. It is caused by inflammation of the periosteum, which results in a well-developed bony formation. The skin along the narrowed portion of the canal is more or less congested. The treatment is that of exostosis.

Molluscous tumours. **Molluscous tumours** of the meatus consist of accumulated laminæ of epidermis and sebaceous matter, enveloped in a thick membrane. Though thus composed of comparatively innocuous material, they have the power of causing absorption of the bone lying in contact with it, passing through it by a clean cut aperture without affecting the bony sides of the canal thus caused, and so pursuing their course pass to and press on the parts beyond, causing symptoms varying according to the parts implicated. The diagnosis of this molluscous tumour from exostosis is made by pressing a probe on the skin over the tumour, and noting the hardness of the enlargement. Laying open the tumour, washing out the accumulated epidermis by the syringe, and withdrawing by the forceps the lining membrane, is the treatment recommended.

Syphilitic affections of meatus. **Syphilitic affections** of the meatus occur as fissures and ulcerations near the orifice, condylomata, and exostoses. The ulcerations exhibit the usual punched-out irregular contour and discharging surface. The treatment is the usual, general and local.

Otitis externa. **Inflammation of the external auditory meatus, or ostitis externa,** is an inflammatory affection of the cutaneous tissues of that canal, involving more or less, according to the violence of the attack, the periosteum of the osseous part of the canal and the membrana tympani. The patient complains of a continual itching sensation, with a feeling of heat and dryness, in the canal, which compel him to pass any suitable instrument which may be at hand into the meatus for the purpose of scratching the part implicated. This irritation may pass off without forcing the patient to seek advice, or it may pass on to one of pain shooting over all the affected side of the head, increased by every motion of the head, or by mastication, and accompanied by a feeling of fulness in the ear, by fever and deafness. After this congested state has lasted for two or three days that of exudation enters, at first as a bright watery discharge, which gradually assumes a mucous character, and this in its turn gives way to a yellow purulent appearance. The pain, which till now has

Symptoms.

been usually severe, subsides when the purulent discharge shows itself, or soon afterwards, and the patient feels lighter and freer of the sensation of "numbness" or "fulness" of which he before complained. A favorable termination without any treatment may now take place, though more frequently the affection becomes chronic and the patient suffers from recurrent attacks on being affected by any exciting cause.

Appearances. In examining the ear it is not always easy to arrive at a satisfactory diagnosis on account of the painful swelling of the canal, which is particularly sensitive about the middle third, and resents the introduction of a speculum. When you are able to introduce the speculum sufficiently well to see the inner part of the meatus you may find a mass of moist or macerated white epidermal lamellæ obstructing your view of the membrane, necessitating the careful use of the forceps or injection of warm water for their removal. Having removed these and obtained a view of the membrana tympani, you find in those cases in which that membrane is affected (and it is rare that you are consulted before it is so), the vessels of the membrane increased in number and size and fully injected, or, if the case has reached a further stage, the single vessels are no longer visible, and the whole has a resemblance to a red blennorrhœic conjunctiva. The natural angle formed by the skin of the external meatus and its continuation with the dermoid layer of the membrana tympani is obliterated, or nearly so, by the pressure of the exudation inside the cutaneous tissues. But the exudation may be so great and may have so narrowed the canal of the meatus that only a small part of the membrane can be seen, its appearance depending upon the part seen and the stage of the affection. The acute stage being neglected, it passes gradually into the chronic form, in which there is generally little swelling of the meatus, possibly here and there slightly macerated or pus-covered spots which bleed easily on being acted on by the speculum, or brown, badly smelling crusts standing upon half-dried secretions. The amount of secretions vary from a moisture discernible at the external opening of the meatus to three or four ounces daily of a high-smelling yellow yellow discharge, and changes by the seasons and other influences. The alarming results of the affection are dependent upon the continuance of this otorrhœa, which, if of long standing, may cause opacity or thickening of the membrane, polypi, maceration of the surrounding tissues, with ulceration of the membrane and its consequences, inflammatory and purulent processes in the dura mater and its sinuses. These latter are especially frequent in children in whom the conditions for the transmission of such processes are easy.

The diagnosis of this diffuse inflammation of the meatus from that of furuncle of the meatus is made by means of a speculum in which a small mirror placed at the end of the instrument may be revolved so as to give the observer a reflected image of the different parts of the meatus in succession, or by means of Blake's small mirrors; or should neither of these be admissible by the contraction of the meatus, by the moist appearance of the dermoid covering of the membrana tympani in furuncle, the same layer in otitis externa having the appearance of the rest of the meatus.

Causes. The causes of inflammation are the passing of any acute or chronic exanthemata to the meatus, irritation or injuries to the ear, as by the application of heat or spirits to the meatus, the prolonged use of in-

jections, the pressure of foreign bodies, the passage of cold currents of air or water, the non-drying of the ear and hair round it thoroughly after washing, the presence of fungi, and, in short, anything causing a congestion and irritation of the lining membranes of the meatus.

The affection may run its course in ten or fourteen days if the purulent stage has not been reached, but that stage having supervened it lasts from five to eight weeks generally.

Prognosis. The prognosis in a usual primary case under treatment is favorable, but relapses are common. The form following an acute exanthem is very different, as should the middle-ear inflammatory process be well developed, and the membrane much affected, the chances of saving an entire membrane are lessened.

Treatment. The treatment is etiological. If there are foreign bodies present their removal demands your first attention, and after this the prevention of any purulent accumulation and the use of frequent injections of warm water are the chief treatment. Should the swelling be great, scarification of the meatus, or an incision and abstraction of blood by the vacuum speculum, seems to be of more use than any other means in causing a speedy subsidence of the thickened membranes, which you may also assist by keeping up a pressure on the circumference of the canal by charpie gently pressed into the meatus, being careful that the charpie is frequently renewed and the meatus cleared of discharge.

Wilde's incision. What is called Wilde's incision, from its having been first brought into notice by Sir William Wilde, is a favourite means of remedy with some, and in the relief of pain, or as a means of giving exit to any exudation which may have passed towards the mastoid process, is very useful. It consists in making an incision down to the bone over the mastoid process, at a distance of from half to three quarters of an inch from the auricle, carefully avoiding, if possible, severing the posterior auricular artery. The application of leeches in front of the tragus (should the patient be too timid to allow of the abstraction of blood by incision or scarification) is advisable where the pain is severe. During the painful stage no strong astringent lotions must be used, those of a sedative nature being preferred, as morphia, in the strength of gr. j to aq. dest. ℥ss, or sulphate of atropine gr. ij to ℥j. This stage being passed, the use of the customary astringent lotions—alum, sulphate of copper, sulphate of zinc, in solutions of from one to four grains to the ounce, or nitrate of silver of from ten to twenty grains to the ounce—are, with attention to any complication of the middle-ear apparatus and to the diathesis present, sufficient to ensure a favorable course. Should the affection have assumed the chronic form, stronger solutions of the astringents mentioned ought to be employed; and the keeping up of a counter-irritation behind the mastoid by tincture of iodine, cantharides ointment, or other irritant, will be found serviceable.

Polypus.

Polypus. Aural polypi generally show themselves during a chronic purulent discharge from the tympanic cavity or external meatus, and are not only caused by such a discharge, but are themselves a means of increasing it by furnishing an additional secreting surface, and, by preventing the exit of discharge, keeping the parts pressed upon by the pus in an unhealthy irritable condition. They are of different forms and appearances, being of a lively red, rich in blood, soft and easily

bled by touching, or firm and solid with a glaucing surface, grape-like or ragged, so small that their presence can only be determined by a careful inspection of the deeper parts, or so large that they protrude from the meatus. Their positions are as varied as their forms, as they arise from any part of the meatus or tympanic cavity or membrane, the different authorities not being agreed as to which are the most frequent sites. Happily their diagnosis and treatment are the same, the former being their capability of displacement by the sound, and the latter their removal either by caustics, astringents, the forceps, scissors, knife, hooks, the galvanic cautery, or Wilde's snare. If the polypus is sensitive, which is not usually the case, and the patient will not suffer the removal by instruments, the application of undiluted liquor plumbi, or alum, or tannin powder, regularly for a time, care being taken that each new application meets with a clean surface, will suffice; but the treatment above all others is the immediate removal by instruments as far as possible, and the application thereafter to the root of some caustic, such as acetic, nitric, or chromic acid, by means of a glass rod or a piece of wood. The instruments employed for the purpose are numerous, those which I find most useful being Wilde's snare, Durham's forceps, and Hinton's forceps. Wilde's snare is especially valuable, as by its means you are capable of reducing a polypus to a considerable extent without endangering any of the structures near it, while the others have the advantage of easier adaptation to an excrescence which is difficult of reaching. Should the polypus be very small, or so situated that you cannot use a cutting or tearing instrument, the application of a thin layer of nitrate of silver, obtained by heating a crystal of the caustic over the flame of a spirit lamp and placing a probe or piece of stout silver wire against the heated crystal, will be found useful in cauterising it, and at the same time limiting the application to the desired spot, which is not so easy when solutions are employed. After the removal of the polypus the disease, of which the growth was only a symptom, must be attended to.

Treatment.

Affections of the Middle Ear.

Affections of the middle ear.

Injuries to the membrana tympani.—Rupture of a healthy tympanic membrane is usually caused by the introduction of some sharp instrument through the external meatus, the efforts to extract some foreign body from that canal, or by a sudden concussion over the auricle, as by a blow from the hand, the unexpected explosion of artillery, or such like. The diagnosis of rupture in such is easily ascertained, but medico-legal questions sometimes arise in which it is necessary to determine whether a rupture was caused by a blow on the ear or was present before the blow was given, or whether the membrane was in such an unhealthy condition that it would be easily injured. The rupture of a healthy membrane caused by a blow is usually a long gaping tear,—the gaping depending on the action of the radiating fibres of the middle layer,—the edges of which have a coating of blood upon them. The rest of the membrane is healthy, free of thickening, opacities, cretaceous or other deposits, though possibly hyperæmic. On passing a current of air through the Eustachian you hear a continuous broad soft sound, unlike the broken hiss from the perforation of a diseased membrane, unless some time has elapsed since the rupture was made, in which case infiltration and exudation may have occurred, giving the appear-

Injury to the tympanic membrane.

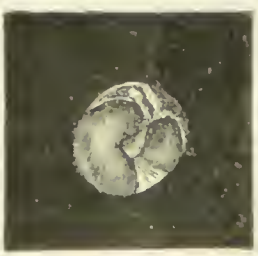
Rupture of membrane.

anees and sounds of a diseased membrane. The prognosis, unless pus has formed to some extent, and deafness to a considerable extent is present, is very favorable, and the perforation will be quickly healed without further treatment than keeping the membrane protected from cold. Should, however, considerable deafness and tinnitus have occurred from a blow, either with or without rupture of the membrane, the prognosis is unfavorable, as probably the stapes has been driven into the labyrinth, tearing the nerve-fibres and possibly remaining fixed there, and you must keep the patient a lengthened time under observation before giving any opinion of what the results will be. Prognosis of rupture.

Inflammation of the membrana tympani, or myringitis, is probably always associated with some affection of the internal or external parts contiguous to it. The diagnosis and treatment will be found in the description of inflammation of the external meatus. Myringitis.

In examining the membrana tympani the points to be noted are its colour, transparency, lustre, light cone, inclination, curvature, entirety, tension, whether adhesions are present or not, and the position of the mallens, especially of its short process. For a full description of these we must refer the reader to Politzer's 'Belcuchtungsbilder des Trommelfills im Gesunden und Kranken Zustande,' Wien, 1865, but the following short note of changes seen in the most common affections in which it is implicated may be found useful in diagnosis. In acute inflammation the membrane is smooth and glistening, and more or less red according to the amount of hyperæmia present. When the mucous layer is hypertrophied, and accordingly a greater amount of secretion present than in the normal state, the membrane is less shining than natural, and has a whitish-grey parchment look. If there is a considerable accumulation of mucus which has lain in contact with the membrane for some time, it assumes a sodden appearance as if the parchment had been steeped in fluid. The changes of inclination and curvature of the membrane depend upon closure of the Eustachian tube, adhesions to the other walls of the cavity, accumulations of pus, mucus, or tumours, internal or external to the cavity, and perforations or thinnings of the membrane, and can only be diagnosed by seeing numerous cases at an aural clinique. The fact that usually only one eye is brought to bear at a time on the membrane makes it difficult for the observer to judge of displacement, protrusions, or any changes in which the judging of distance is required till he has accustomed himself to the use of one eye only. Examination of a tympanic membrane.

Fig. 114.



Appearance of membrana tympani, showing the relation of parts to each other (Right ear.)

Chronic perforation of the membrana tympani is one of the most common affections of the ear on which you will be consulted. The diagnosis of the affection is easy, either by the speculum, by asking the patient to drive a current of air by a forcible expiration through the Eustachian tubes, the nostrils and lips being held firmly together,—this method being called Valsalva's method—by passing a current of air from Politzer's bag, as described under malformations of the external ear, or by passing the Eustachian catheter and forcing a current of air from Perforation of the membrana tympani.

the mouth or from an india-rubber bag through the catheter. By these three last methods you will obtain—the Eustachian tubes being open—a sound more or less of a hissing character, depending upon the rush of a column of air through a small orifice. The usual causes of the perforation of the membrane apart from those of a traumatic origin are scarlet fever, measles, tuberculosis, and any greatly debilitating affection in which the mucous membranes are affected.

Prognosis. The prognosis is regulated greatly by the dyscrasia present, but it ought always to be remembered that a perforation may heal without leaving any discernible pathological changes, and without in the slightest recognisable degree lessening the power of hearing. The hopes for such a happy result are the greater the shorter the acute attack which has caused the perforation, while it is rare after a chronic affection accompanied by otorrhœa; but no opinion ought to be hazarded till you have carefully washed out the ear and seen the extent of the perforation and losses which have already resulted therefrom. The process of healing is known by a gradual diminution of the secretion and of the perforation, the cicatrix being formed by the dermoid and mucous layers, but of a much more delicate structure than the natural layers, and not separable into laminæ. The hopes of

Treatment of perforation. cicatrisation are at an end for the time when the edges of the perforation become cicatrised and a gap still remains, but a new impetus may be given to the regeneration by any future affection which causes a hyperæmia in the part and a softening of the cicatricial edges of the perforation.

In the treatment of a perforation the rule is to close it if possible, on account of the exposure, caused by the perforation of the tender mucous membrane of the tympanic cavity to cold air or water, dust and other foreign bodies. These by their irritation may cause a purulent discharge, and that being once present may lead to results of the most disastrous nature. But if the perforation have existed some time, and be of a considerable extent, the question arises whether the closing of the perforation will not impair the patient's hearing power, and before doing anything to close such it is advisable to temporarily close the gap by a drop of glycerine or other thick fluid and note the effects. Should the result be to lessen the hearing power to any considerable extent, you must carefully consider the probabilities before determining upon your action. While the affection is still in the acute stage, the keeping of the parts clean by gentle injections, and the use of some slight astringents for the purpose of reducing the secretion of the membrane and bringing it into a more normal condition, are all that are required, with the use of a little wadding in the ear when the patient goes out, unless the weather is very mild, when the latter may be dispensed with. Should discharge be present which by some means has become thickened, and by its presence closes or tends to close the Eustachian tube, Politzer's operation ought to be done now and again; and if this is not sufficient of itself the softening of such an accumulation by an alkaline solution as bicarbonate of soda ʒss—ʒj to an ounce of water, and then the Politzeration will suffice to remove it.

Closure of perforation. Should you determine to try to close a large perforation you carefully and gently stimulate the edges of the perforation by the application to them of nitrate of silver or other irritant, either in solution or by touching the moistened edges with a thin layer of the crystals placed on a

probe as mentioned in the treatment of granulations, or by abrading the edges with a knife, conical file, or plug of wadding, turned in the perforation. But if you fail to close it by the growth of new cicatricial tissue, and yet believe that its closure would improve, or at least not impair, the hearing capability, you may resort to the artificial drum, the success of which in some cases is very great. Numerous modifications of artificial drums have been proposed, but the most simple, most easily applied, and one that is as successful as any other, is a piece of cotton wadding moistened in water or some antiseptic solution, and applied over the perforation and lapping considerably over the edges. The difficulty of its use is its first adaptation, but if once applied successfully the patient can adapt it in future for himself more truly and quickly than his medical attendant. The conclusion as to whether it will be of benefit or not must only be arrived at after several attempts have been made, changing the point of pressure and adapting it more closely to the remnant of natural membrane at different points at each attempt. When it has been used for some time with success the patient feels it very inconvenient to be without it. If found of service, it ought not to be worn above an hour or two at a time for some days, gradually increasing the duration of its application, but always removing it at night, and the patient should be directed to attend to the most perfect cleanliness at each renewal of the wadding. How the artificial membrane acts is still a matter of doubt. It is considered that it is a support to the ossicles and membranes, and this is probably its action in the majority of cases. From observations at the different positions in which they increase the hearing power, I think they may have also a resonating action.

Artificial membranes.

Artificial perforation of the tympanic membrane.—Having spoken of the means of closing a perforation, it is convenient here to speak of artificial perforation of the membrane. The operation is recommended in cases of accumulations of pus or mucus within the tympanic cavity, of impassable stricture of the Eustachian, of thickening of the membrane, of adhesions of the membrane to the tympanic walls, in cases of tinnitus, and in cases where no benefit is derived after prolonged use of other curative means and the diagnosis is not clear, but the acoustic is not much affected. That benefit may be derived in all such cases cannot be denied, but unhappily we are not yet in a position to say that perforation will benefit this or that case, except in cases of accumulation. The point of operation is determined in cases of accumulation by the point of the membrane at which bulging is present, while in other cases a spot behind the manubrium is usually chosen. Bringing the membrane well into view by the usual method, the operation is made by means of one of the numerous instruments which have been proposed for the purpose. If it is merely as an experimental proceeding, to determine whether an opening will be of benefit to the hearing, or for the purpose of allowing the exit of pus or mucus, a small, plain, double-edged scalpel is all that is required. Having made the opening sufficiently large, you remove all impediments to the passage of sound by causing an air douche to be passed through the cavity by one of the usual methods, having, if necessary, previously softened any accumulations. It being thus empirically determined that a permanent opening in the membrane would be desirable, you attempt to keep the opening from closing by a bougie or Politzer's

Artificial perforation of the tympanic membrane.

eyelet, by making the perforation by the galvano-cautery, by removing a part of the malleus with a portion of the membrane, by the constant use of the air douche, by repeated removals of the cicatricial membrane, by digestion with pepsine, acids, &c. But as yet no method has been proposed which acts with certainty of success.

Catarrh of middle ear.

The ordinary *affections of the middle ear* which the general practitioner will be called upon to treat are included under the title of "catarrhal affections," and may be of an acute or chronic character.

Acute catarrh.

The principal objective symptoms of acute catarrh are a hyperæmic swelling of the mucous membrane, with an increased secretion therefrom, the pharyngeal mucous membrane near the orifice of the Eustachian tube leading to the affected ear being nearly always implicated. This state of the mucous membrane gives to the observer who passes a current of air through the Eustachian tube and listens by means of an otoscope, one end of which is placed in the meatus of the patient and the other in his own, sounds ranging from a harsh dry sound, like that caused by distending a dry bladder, to a true mucous râle. The tympanic membrane varies in appearance, according to the stage of the affection, from that of a glancing polished copper plate to that of a dull wet bladder, from which all bright reflex has gone, corresponding to the dry and infiltrated states of the tissues. A more or less obliteration of the malleus may be present, depending upon the passage of the exudation between the layers of the membrane. A bulging of the membrane will be observed should an accumulation of fluid have taken place to a considerable extent. The chief subjective symptoms are a pain in the depth of the ear, which is increased by every motion of the parts, such as by coughing or swallowing, an impairment of hearing, a feeling of heaviness, fulness or pressure in the ear, often described as a "drop of water in the ear" tinnitus of various characters, as singing, knocking, or surging, the position of which, whether outside or inside the head, the patient cannot always tell, giddiness, confusion of thought, and other symptoms of pressure. The subacute form is merely a combination of the same symptoms in a milder degree. If the case is properly attended to while in the acute stage no graver disturbances of the organism ought to arise, but it must always be remembered that the tendency of the affection being to thickening and swelling of the membranes implicated, adhesions and solderings are apt to take place between the closely situated delicate structures of the tympanic cavity. The general position of such adhesions is between the manubrium and promontory, the tympanic membrane and incus or stapes, the tendon of the tensor tympani and stapes, and especially often in the niches of the two fenestræ, binding the walls together or to the stapes.

Chronic catarrh.

But should the acute stage be neglected the acute passes into the chronic form, generally, like the acute, implicating both tube and cavity. It may, however, be localised, and consist in repeated swellings with gradual condensations and thickenings of the mucous membrane, which becomes gradually less elastic, and by proliferation form bands in the cavity. These by their physical qualities as well as by their interference with the swinging faculty of the sound-conducting apparatus materially interfere with the hearing capabilities. This chronic form, once established, is most obstinate to treatment, and leads to increase of the deafness, which depends more on the locality

of the changes than on their extent. It also causes an increase of the symptoms of pressure, the tinnitus possibly becoming so harassing that persons have been known to have committed suicide to escape from it, and often causing such depression by the effects of the vertigo and vomiting which it occasions that an inclination to resort to intoxicating fluids is thereby aroused.

Prognosis.

The prognosis is generally favorable, but the treatment is prolonged over such an extent of time that the patient frequently ceases to attend before restoration is accomplished, or aid is not sought in time to prevent changes which, having once occurred, cannot be undone. In these cases we must endeavour to stay the course of the disease, which if left to itself will certainly lead to total deafness. The older the patient, the more chronic the affection, and the greater the changes formed in the tympanic cavity, the less hope is there of a good result. If the tinnitus is continuous and has been present for some time, the prognosis is unfavorable, even although under treatment the hearing power is improved, while if nearly total obliteration of the cavity has occurred, especially if chalky deposits are present on the tympanic membrane, a favorable prognosis is almost negatived.

Treatment.

The treatment, besides the constitutional and hygienic, consists in local bloodletting, while the pain and hyperæmia are present, the application of the air douche, the injection of medicaments to the Eustachian tube and tympanic cavity, the treatment of any naso-pharyngeal affection which may be present, and the performance of different operations on the sound-conducting apparatus. Two methods of passing a current of air into the tympanic cavity through the Eustachian tube have been already described (p. 386). The passage of the Eustachian catheter, used either for the conveyance of air, fluids, or vapours, or for the better guidance into and through the tube of bougies, elastic catheters, or instruments for electrical purposes, is by no means so difficult as is generally believed. The silver catheter with an obtuse angle of from 110° to 120°, is, I find, the most generally useful in the hands of those accustomed to pass it. The caoutchouc ones are apt to break after being used some time, and do not convey to the operator such accurate knowledge of the position of the beak, in relation to the structures over which it passes, as those composed of metal, although the caoutchouc are less likely to make a false passage in the hands of an inexperienced operator. The patient ought to be placed with the external openings of the nares horizontal and opposite to the right shoulder of the operator, who, tilting the point of the nose upwards by the fingers of the left hand, discloses the cavities of the nares more fully, upon the floor of one of which he places the beak of the catheter. Keeping the beak on the floor, he passes it through the cavity and onwards across the pharyngeal space, till it comes against the posterior pharyngeal wall, which, in its normal condition, gives him much the same feeling of resistance which he receives on pressing the catheter against the tense open palm of the hand. Drawing the catheter towards him, and at the same time elevating the end which he holds in his hand, he brings the concave curvature of the opposite end against the posterior edge of the nasal floor, and then turning the beak outwards and upwards, keeping it at the same time against the external lateral wall of the pharynx, he will feel it make a slight dip into the pharyngeal opening

Method of passing the Eustachian catheter.

of the Eustachian tube. The above method is the one usually adopted, but there is that proposed by Bonnefont, which consists in turning the beak of the catheter from the posterior pharyngeal wall outwards into Müller's depression, and drawing it then towards you till you feel that it has passed over a swelling and then fallen into a depression; or Luwenberg's, consistiug of turning the catheter beak inwards after reachiug the post-pharyngeal wall, drawiug it towards you till the curve catches on the posterior edge of nasal septum, and then revolving it upwards or downwards towards the lateral pharyngeal wall, when it will probably pass into the tube. If there is a difficulty in passing the catheter through the nasal cavity it is generally most easily overcome by keeping the beak towards the external wall and passing along it. But should you fail in passing it through the nostril corresponding to the Eustachian tube, into which you desire to introduce it, by using a catheter with a longer curve you can reach the mouth of the Eustachian tube from the other nostril, or you may pass it into the tube from the mouth. You know that the nozzle has passed well into the mouth of the tube hy the position of the catheter not being disturbed when the patient speaks or swallows, by the fact that the nozzle will not pass further upwards, and especially by the fact that on blowing air into the catheter, either by month or india-rubber bag, you recognise its passage into the tympanic cavity of the patient by having placed a tube of communication from his meatus to your own. In children the outward turn of the catheter is usually more limited in extent than in the adult, iu whom it is generally from a fourth to three eighths; but a latitude must be allowed, as the formation of the part varies. In a new patient, if you wish to pass the catheter into the Eustachian tube, it is advisahle to try the right side first, as it will be found usually easier to pass ou that side on account of the septum gently inclining towards the left. The mistake generally made is that the catheter is not brought sufficiently forwards after having reached the posterior pharyngeal wall, so that the beak falls into the depression posterior to the opening of the tube. But this may be casily averted hy attending to the directions above given as to feeliug pressure of the curve ou the back of the septum or soft palate before turning the beak outwards.

Tympanic catheter.

Dr. Weber-Liel, of Berlin, has lately introduced a small clastic catheter for the purpose of securing the passage of injectious directly into, or the removal of accumulations from, the tympanic cavity. This is passed through the usual silver catheter as a director to the tube, and having thus, ou its exit from the silver catheter, obtained a position in the tube, it is passed on with a little care through the tube and into the tympanic cavity.

The iujectious passed through the catheter consist of preparations of potass, ammonia, iodine, mercury, silver, ziuc, atropine, chloral, &c., iu solution, care being taken that the fluid is lukewarm at the time of entrance.

Injections passed into tympanic cavity through the Eustachian catheter.

The following solutions may be found useful:—Sulphate of zinc in varying strengths from oue to ten grains, of muriate of ammonia five to twenty grains, of iodide of potassium ten to sixty grains, iodine one to five graius, chlorate of soda five grains, to the ouuce of distilled water. Before using them always see that the tube is pervious and cleared of mucus or other removable obstruction to their entrance. They are probably most useful when employed every second or third

day, for from three to eight weeks, after which an interval of a month or more of rest is advisable before continuing their application. The injections through the elastic catheter, passing directly into the tympanic cavity, ought to be much weaker.

Should objections be made to the passing of the catheter, so that you cannot use it in passing fluids or vapours to the ear, the instruction of the patient in doing Valsalva's method of inflating the tympanum, by which he may drive steam, impregnated with a little iodine and acetic ether, will serve the purpose. The method of doing so is as follows:— Having placed from ten to twenty drops of a solution consisting of equal parts of tincture of iodine and acetic ether in a pint of hot water, the patient inhales a mouthful of the steam, and, having closed the nostrils with the fingers, makes a violent expiration, keeping the mouth and nostrils firmly closed. The steam by this forcible expiration is driven against the walls of the naso-pharyngeal space and mouth, and the Eustachian tubes being the only spots for exit, rushes up these and fills the tympanic cavity, a sensation of fulness, and possibly warmth, being felt in the ear by the patient if the operation has succeeded. This ought to be done several times at a sitting, the patient swallowing between each inhalation. But should the Eustachian tubes be not rendered pervious by the force used, as is not unfrequently the case when the mucous membrane is considerably swollen, the catheter must be resorted to, as by the passage of a current from an india-rubber bag directly through the catheter to the tube an obstruction which will not give way to Valsalva's method will be overcome. Method of inflating tympanum.

The treatment of the naso-pharyngeal space consists in topical application to the mucous membrane of the space of astringents such as alum, tannin, or nitrate of silver. A very useful form is the drawing of a solution of alum up the nostrils, allowing it to pass back into the pharyngeal space, expectorating it, and then blowing the nose violently. When the alum is thought not sufficient for the condition present in the pharynx, a nitrate of silver solution of from ℥ss—℥j to the ℥ of water applied to the pharynx, and especially to the membrane round the Eustachian regions, will be found a valuable agent. The patient being seated so that good light is thrown into the mouth, and the tongue being depressed by a tongue spatula or the index finger covered by a stall, he is desired to take a deep inspiration, at which moment the surgeon takes the opportunity to pass the brush, which has been dipped in the solution, to one of the Eustachian regions, and, making a half revolution upwards, passes over the whole roof of the space to the Eustachian region of the opposite side. The use of gargles at home between the applications of the caustic is to be recommended.

Professor Gruber and others use what is called the nasal douche, by driving from a syringe, the nozzle of which fills one nostril, the other being closed by the fingers of the operator, a current of some astringent solution up one nostril and so into the other, the obstruction to its exit from the other nostril by the fingers regulating the force with which it acts on the pharyngeal walls. But it is so difficult to regulate that force with the resistance of the Eustachian tubes, that the fluid may pass into the tympanic cavity with such a rush as sometimes to do serious damage, and accordingly I would not advise its being applied by those unaccustomed to its use. Nasal douche.

Operations on tympanic membrane.

The operations on the tympanic membrane and structures of the cavity are perforation, division of adhesions and tenotomy of the tensor tympani. The perforation of the membrane has been spoken of at p. 401. The division of adhesions and of the tensor tympani is made by small curved bistouries or by revolving cutting hooks made for the purpose. Those of Weber-Liel, and Gruber, will be found most useful. The determination of adhesions, with their exact positions, is best made by using Siegle's pneumatic speculum, by which, on creating a vacuum in the meatus, you are able to note what part of the membrane is bound down and does not fall into the vacuum with the rest of the membrane. It requires a considerably lengthened experience in aural diagnosis to be certain of the necessity for or advantage to be derived from such operations.

Otitis media.

Otitis media or purulent catarrh is merely a higher grade of inflammatory mucous discharge, but it has always a much more unfavorable prognosis than simple catarrh. The symptoms are much the same as in simple catarrh, but more violent, being accompanied with severe pain, fever, and nearly always leading to perforation. This, should there be an accumulation of considerable extent in the cavity, is to be desired rather than feared; because should the membrane not give way, as is apt to be the case in a thickened membrane from chronic catarrh, the pus is apt to find its way through some of the many passages which often exist between the tympanic and cerebral cavities, and so cause meningitis.

Treatment.

The treatment is conducted on the usual principles. Give the pus every opportunity of free exit, either by natural or artificial channels, and thus allay fever and pain and save time and tissue. Leeches, opiates, purgatives, and warm-water injections into the meatus, keeping the Eustachian open so as to have a natural drain, if necessary, perforation of the membrane at the point of bulging, and when otorrhœa has occurred regular syringing of the ear with lukewarm water, to which an antiseptic or astringent has been added, are what are generally found successful. To make the astringent employed pass into the cavity and through the Eustachian tube it is useful to fill both canals with the astringent, causing the patient to keep it there till you pass a current of air through the Eustachian, on which the fluid in the external canals will rush into the cavity and Eustachian; or by driving a current of fluid with or without medicaments through the Eustachian tube and tympanic cavity from one side or other. In addition to the local treatment that of the constitution must be attended to, the residence of the patient in such chronic discharges being of especial importance.

Purulent catarrh.

The pus catarrh of children is often most insidious in its progress, and may cause great injury before its presence is suspected. Till a discharge appears, probably the ear has not been looked upon as the seat of any disease, on account of the child's inability to localise its pain or tell of its deafness. The screaming of the child when pus has formed is loud and persevering, especially at night, is increased by every movement, or concussion of the body, especially by movement of the head, and above all, by sucking at the breast, which at last becomes so painful that the child refuses to take the breast entirely, preferring to be fed by the spoon. In nearly all the cases of suppuration in the tympanic cavity which comes before the surgeon, the pus has already made its way through the membrane, and the child is brought to you on account

of the discharge from the ear. Should you, however, see the child before the pain is relieved, you may by the timely use of the remedies mentioned as useful in otitis media and the free opening of any enlargement over the mastoid process, with, if necessary, opening into the mastoid itself if there be indications of pus-accumulation there, prevent the destruction of valuable structures. The great cause of the affection is scarlet fever, though measles and typhoid fever contribute largely to the number of cases. Treatment before perforation of membrana tympani.

When the acute purulent has become chronic there is a wide-spread prejudice amongst both the laity and professional men against the stopping of such a discharge by treatment. This prejudice cannot be too strongly combated, as though in such chronic cases there are generally present slight deafness and only occasionally pain, we can never be certain that complications arising from the constant otorrhœa, such as polypi, paralysis of the facial, ulceration, caries and its results, will not occur. Treatment after perforation.

Affections of the labyrinth.—The chief symptoms of this class of cases are great deafness, gradually or suddenly acquired, diagnosed by the patient's inability to hear the vibrating fork when placed on the bones of the skull, vertigo, tinnitus, with possibly nausea, vomiting, and pain. The conditions causing such affections are believed to be hyperæmia of the labyrinth or hæmorrhage into it, inflammation of the labyrinth, which is generally in children considered under the term of meningitis, and malignant affections. But affections of the internal ear are much more numerous as secondary affections resulting from an extension of disease of the middle ear, meningitis, fevers, tumours, aneurism, anæmia, hysteria, childbirth, or syphilis. With the latter, arising from hereditary syphilis, are generally seen the syphilitic physiognomy, and in all the cases which have yet come before me in which the acoustic was considerably impaired, changes in the choroid were invariably found if the media were sufficiently clear to allow of a view of the retina being obtained. The treatment, should syphilis be the cause, is not entirely hopeless, but if from other causes is almost nil. Strychnia, quinine, morphia, and local remedies have their different advocates. Electricity may be tried, but a sufficient number of carefully recorded cases is still required before an opinion of its value can be given. Affections of internal ear.

Deaf-mutism.—By far the majority (above three fourths) of the cases of deaf-mutism arise from congenital affections, the remainder resulting from fevers, teething, hydrocephalus, convulsions, &c. The hereditary influences are undoubted, and when such are present it is often seen combined with retinitis pigmentosa. The pathological conditions found in such are changes in the tympanic cavity with defects in the sound-conveying apparatus, abnormalities in the labyrinth or cerebrum, especially near the fourth ventricle. But the inner ear or cerebrum may have no perceptible changes sufficient to account for such a high degree of deafness as is present. The treatment is the careful cultivation of any remnant of hearing which may be present, and the placing of the child in an institution for the education of deaf mutes, where by the careful watching of the lips of the speaker they are able to follow him in conversation, and by a laborious teaching of the positions in which the organs of speech are to be placed in forming the different syllables, they are rendered capable of answering. Deaf-mutism.

SURGERY OF THE CIRCULATORY SYSTEM.

CHAPTER X.

WOUNDS OF THE HEART AND ARTERIES—HÆMORRHAGE AND ITS TREATMENT.

Wounds of the Heart.

Wounds of the pericardium.

ALTHOUGH it is quite possible for the anterior mediastinum to be traversed from side to side by a foreign body without any important structure being wounded, it is far more common for some severe lesion to be the result, such as a wound of the pericardium, heart, lung, or of the great vessels. A wound of the *pericardium alone* may occur, and not prove fatal. Dr. G. Fischer has collected fifty-two reputed cases of this nature, including punctured, incised, gunshot, and lacerated wounds, twenty-two of which recovered. The chief danger of this local injury lies in secondary inflammation of the membrane. From a unique preparation shown by Mr. Morant Baker in May, 1877, at the Pathological Society, it would seem that an omental or other hernia may take place from the abdominal cavity through the diaphragm into the pericardium by an aperture, the result of some antecedent stab.

Paracentesis.

The operation of "paracentesis pericardii" has been performed with advantage.

Wounds of the heart.

Wounds of the heart itself are generally mortal, death taking place immediately in about one fourth of the cases; in the bulk of the remainder after a few days; rare instances recovering. The symptoms

Symptoms.

of a wound of the heart are very uncertain, but the most important, says Poland, "is the presence of a *lesion* in the neighbourhood of the heart, with *external bleeding*, followed by all the signs of sudden

Collapse.

interual hæmorrhage." Sudden *collapse* is a very general consequence of the injury, and, when it comes on some time afterwards, it is probably due to secondary hæmorrhage from the giving way of the clot

Dyspnœa.

in the wounded heart. *Dyspnœa*, according to Fischer's Analysis, is not constant, and, when present, seems to be due to compression of the heart by the effusion of blood into the pericardium and pleura.

Pulse.

In some cases it is immediate and intense. The *pulse* is often unequal, small and intermitting. *Pain* is uncertain. The position of the external

Diagnosis.

wound is a valuable aid to diagnosis, and it is well to remember that the sternal end of the second left intercostal space corresponds to the left side of the base of the heart, and the lower margin of the fifth rib to the apex. In a medico-legal sense it should also be known that "when a person is found dead with a wound in the heart, attended with abundant hæmorrhage, it must not be supposed that the flow of blood took place in an instant, or that the person died immediately, and was utterly incapable of exercising any power." (Taylor.) The symptoms as well

Duration of life.

as the duration of life are much influenced by the direction and size of the wound. Thus, if made in the course of the muscular fibres there will be little or no hæmorrhage, and consequently less collapse and dyspnœa; but if the heart be cut across, the edges will separate to a

great extent, and sudden death ensue from the immediate gush of blood. In oblique wounds there will be less gaping of the edges. With respect to the cases of recovery, Sanson has recorded an instance in which a cicatrix in the heart was found some lengthened period after the receipt of a wound from which the patient had recovered in twenty-eight days. Velpeau has cited a second, of a man, aged fifty, who died nine years after having received a wound in the left side of the chest from a table knife, and in whom the pericardium was found largely opened and adherent to the parietal cicatrix, while fibrous lines traversed the whole thickness of the right auricle, at a point corresponding to the breach of surface in the pericardium. In the 'Medical Times and Gaz.' of April 4th, 1874, a case is also reported of a Captain B—, æt. 40, who died from dysentery, and after death a leaden bullet was found encysted outside the pericardium, between the origin of the pulmonary artery in front and the ascending part of the arch of the aorta behind. The bullet had entered the chest above the nipple eleven years previously. The heart may also be lacerated by a severe contusion or pressure upon the chest without external wound or fracture of the ribs.—(Thus at Guy's there is a prep. 1400[35], in which both auricles of the heart are lacerated with the pulmonary veins which was taken from a child, aged four, over whose back the wheel of a cart had passed. There is also another in the Royal College of Surgeons of Edinburgh which proves this point.)—The diagnosis and treatment of this form of injury are the same as in cases of wounds.

Laceration of heart without external wound.

Treatment of wound of heart.

Treatment.—As hæmorrhage after a wound of the heart is the main fear, so to prevent and arrest it should be the chief aim. With this object, absolute repose is essential, and should be maintained throughout the case. The local and general employment of cold is also to be advised. To calm the excited action of the heart belladonna and digitalis have been recommended, and so even has venesection. The diet should be nutritious, but unstimulating. When the pericardium is full of blood, it has been suggested to lay open the cavity to let it out, but the uncertainty of diagnosis is sufficient to forbid the attempt. For further information on the subject I may refer to Poland's article in 'Holmes' Surgery,' which contains an admirable analysis of Fischer's paper; also to a paper by West in the 'St. Thomas's Hosp. Rep.,' 1870.

Wounds of the large vessels of the chest.

Wounds of the large vessels of the chest are generally fatal, death being immediate in most cases, from internal hæmorrhage. Dr. Heil, however, records a case in which a man after receiving a stab which penetrated the aorta, recovered and lived a year. Pelletan also cites another, in which a man was run through with a foil, which entered the chest above the right nipple, and came out at the left loin; no violent or marked symptoms followed the accident beyond constant pain in the loins. Two months later, he died somewhat suddenly, in great agony from hæmorrhage into the right side of his chest, and after death, an opening the size of a quill, was found in the aorta above the diaphragm. The Hunterian Museum (No. 1565a) contains a specimen of the ascending aorta of a sailor, in which was lodged a bullet in a piece of integument surrounded by lymph. The wound was produced by a musket ball passing through the diaphragm and pericardium into the aorta; it entered the chest between the eighth and ninth ribs, and was followed by a rush of blood. All hæmorrhage, however, very soon ceased. The man lived three days after the injury.

Examples.

Wounds of the Arteries.

On wounds of arteries.

Complete division.

When an artery is *completely cut across* bleeding may take place, the blood jetting forth *per saltum*, as it is called, with each pulsation of the heart. The blood is usually of a bright red colour, unless the patient be asphyxiated, or fully under the influence of some anæsthetic, when it is often as black as venous blood. Pressure upon the vessels above the wound arrests or diminishes the hæmorrhage, and pulsation in the vessel below is lost.

Partial division.

When, however, an artery is *only partially wounded*, either transversely, obliquely, or longitudinally, the bleeding will probably be less profuse; the blood, under these circumstances, moreover, rarely jets out as from a divided vessel unless the wound be very large, but wells up *in a deep wound*, or flows in a continuous stream, after the manner of venous blood.

Escape of blood may be continuous and colour black.

When red, its arterial nature can easily be recognised, but when black its recognition is more difficult. Should pressure, however, above the wound arrest the flow, and pulsation in the vessel below be lost, the probabilities of the blood being arterial are strengthened. It is an important fact to bear in mind, that when a large artery is partially divided just *below* a large anastomotic branch, bleeding will take place from the lower end of the wounded artery as well as from the upper, while pulsation in the vessel below will only be diminished.

Bleeding from lower end of artery.

When hæmorrhage takes place from a large vessel it is generally so profuse as to destroy life rapidly, unless instantly checked. When from a small it is less copious, and has a natural tendency to stop, at any rate for a time, and to give an opportunity for natural hæmostatics to take effect. It is well, therefore, to consider now how wounded arteries heal, and by what means bleeding can naturally be arrested.

Repair of wounded arteries.

Primary adhesion.

Small wounds of arteries may, doubtless, heal by immediate union or primary adhesion, and larger may likewise for a time be closed by the clot of blood that covers the wound, or even by some stronger reparative material; but "the closure is often ineffectual or only for a time, and fresh bleedings ensue, either increasing the accumulation of extravasated blood or pushing out the clots already formed. In this manner, with repeated hæmorrhages at uncertain intervals, the wound in an artery is often kept open, and, at the end of two or three weeks may show no trace of healing, but rather appear widened and with softened everted edges. In such a case it is possible that the wound in an artery may still *heal by granulations*, either rising from its edges or coalescing over it from adjacent parts; but the *event is too unlikely to justify the waiting for its occurrence*, if there be opportunity for surgical interference, and, even if healing should go so far as to close the opening in the artery yet is it likely to be insecure, for both the elastic tissue and smooth-fibred muscle on which its strength largely depends, are very slowly formed in scars. Hence, a form of traumatic aneurism seems not very rare, in which the sac is chiefly formed of scar-tissue, which closed the wound in the artery and then yielded to the pressure of the blood."—Paget, 'Lectures,' p. 204, ed. 3rd.

Healing by granulation, after Paget.

Partial division of arteries more serious.

Thus a partial is a more serious injury than a complete division of an artery, and requires as prompt surgical treatment, because the means adopted by nature in a divided vessel for the permanent arrest of bleeding are acting at a disadvantage in the one only wounded, and are rarely effectual. In practice, therefore, it is often the object of the surgeon to complete the division of a partly divided vessel, and thus to give

natural hæmostatics a fair chance of effecting a cure. From vessels of small size hæmorrhage, as a rule, ceases after the first rush or, at any rate, as soon as nature's processes for controlling bleeding have had time to act. Indeed, "gradually, with or without surgical help, all the vessels divided by a wound are closed and cease to bleed; the larger being often aided to this end by their retraction among the looser textures, and by the coagulation of the blood within or over their orifices, and by the diminution of the heart's force with the increasing loss of blood. Coincidently the flowing blood becomes gradually brighter and paler. And, if the wound be left open after pure blood has ceased to flow, there is an oozing of blood-tinged serous-looking fluid; and this is gradually succeeded by a paler fluid, some of which collects like a whitish film on the surface of the wound."—Paget.

Conditions favorable and unfavorable to hæmorrhage.

Whatever favours retraction of a divided artery and its contraction, tends to arrest bleeding; whatever hinders these processes prolongs and increases it. Thus, vessels that traverse loose textures cease bleeding more readily than others circulating through those that are close and compact, such as the integument of the head, and sole of the foot; and bleeding from an inflamed or rapidly growing part is checked with greater difficulty than that from other tissues.

Punctured wound of artery. Oblique wound of artery.

The size and form of the wound in the vessel has also much to do with the result. A *puncture in the axis* of a large artery may heal by natural processes and be unattended by much bleeding. A small *vertical* wound may likewise close, whereas an *oblique* wound will gape and is, consequently, attended with copious bleeding, while a *transverse* wound is of all others the most dangerous on account of the difficulty of controlling hæmorrhage and the improbability of natural hæmostatics unassisted by art acting with any permanent advantage. The retracting power of the vessel tends to cause gaping of the wound rather than closure, and encourages rather than checks bleeding.

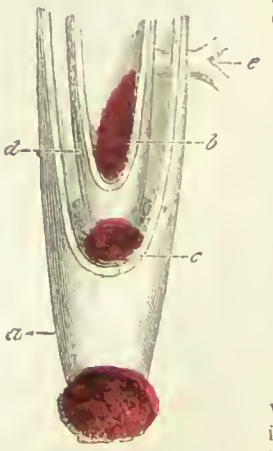
Natural and Surgical Hæmostatics.

Natural and surgical hæmostatics.

When artery is divided.

When an artery is divided across, five things happen. (1) The divided ends (Fig. 115 *d*) *retract* within the sheath (*a*), and (2) by *contracting* diminish the calibre of the canal. (3) Blood coagulates *in the sheath* (*a*) around the orifice of the divided vessel; and (4) *in the artery* itself (*b*) up to the first large branch (*e*); and, lastly (5), *plastic lymph* is poured out from the divided coats of the vessel, and by its organization, the permanent closure of the vessel takes place. The clot subsequently becomes organized and the vessel contracts. In a large proportion of the cases of divided arteries these natural hæmostatic processes are ample of themselves for the arrest of bleeding, while it is only in the larger arteries that any surgical or artificial aids are required.

Fig. 115.



Natural hæmostatics.

When artery is torn across.

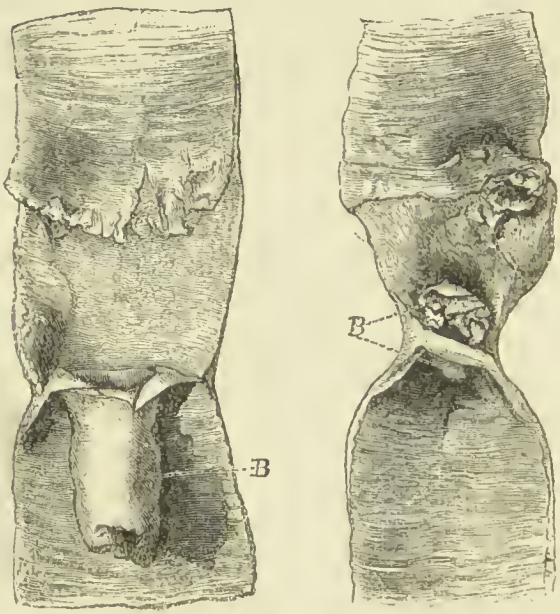
When an artery is torn across, the same changes take place; *but they are carried out to an advantage*, as the stretching or torsion of the vessel before it gives way encourages

its retraction and contraction, and the lacerated edges of the vessel help the coagulation of the blood. It thus happens often that when a large artery is divided by laceration no bleeding occurs. I have seen the femoral and brachial arteries torn asunder and no bleeding follow, and whole limbs avulsed from the trunk without hæmorrhage. The lacerated vessel appears under these circumstances as if drawn out, the elastic external tunic being stretched into a conical form over the inner coats that have been divided and have retracted. An artery divided by laceration or torsion, however large, consequently rarely bleeds, and it was the knowledge of this fact that suggested to Amussat the idea of practising torsion of an artery.

When contused and over-stretched.

When an artery is contused or so stretched as to suffer something less than complete rupture of all its coats, it may become obstructed; and this obstruction is probably caused by a more or less complete circular laceration, or breaking up of its inner tunics; for the different museums contain preparations which prove that an artery so treated, when apparently maintaining its continuity, may have a complete circular laceration of its inner coats, a separation of these coats from the external cellular one, or an incurvation of these tunics into the lumen of the artery, as in torsion (B, Figs. 116-7); the deposition of clot subsequently taking place within the meshes of the divided coats, and, as a consequence the complete occlusion of the vessel.

Fig. 116. Fig. 117.



Laceration and recurvation of internal coats of an artery from external injury. Taken from preparations now in the Museum of the Middlesex Hospital by the kind permission of the surgeons.

Cases.

I have known this obstruction to follow many injuries, and have seen the external iliac artery obstructed in a case of a broken pelvis, in one instance followed by gangrene of the lower extremity, and in a second by cure. I have also known the common femoral artery, the

superficial femoral artery, the axillary and brachial arteries to become permanently closed in a similar manner. It is a question, indeed, whether, as a result of contusion, adhesive inflammation ever takes place in an artery to cause its occlusion without some such laceration of its inner tunics as has been described.

Sometimes a vessel will rupture some days after the injury, at a part that has been severely contused, causing a secondary subcutaneous hæmorrhage, and the sensation of something giving way. Such a result, however, is rare in civil practice; although in military, from gunshot wounds, it is more frequent. The bleeding under such circumstances occurs after the fifth day. Cold lotions will, generally, suffice to induce absorption of the blood when the hæmorrhage is slight, although in some cases the fluid blood may be drawn off with a good result. In exceptional cases, an aneurism may form and requires treatment. Secondary subcutaneous hæmorrhage.

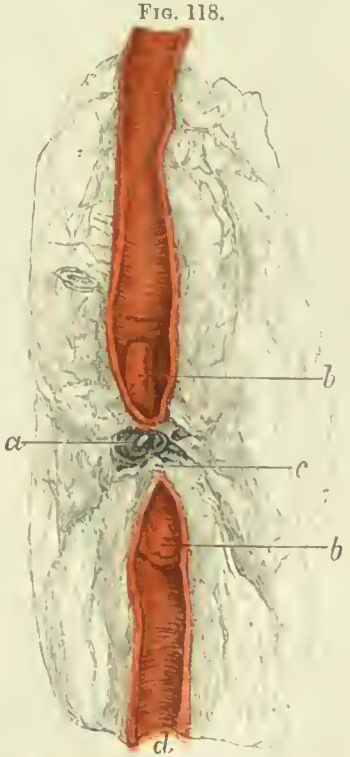
It having been asserted that it is by natural processes alone that divided vessels are permanently sealed, and arteries in continuity occluded, it will be well to inquire into the modes of action of the different means which the surgeon has at his disposal to bring about these results; and it may be stated *in limine* that the means are to be regarded as good, in so far as they aid the natural processes that have been described and turn them to account. Surgical hæmostatics.

Thus, the *exposure of, and the application of cold to*, a divided artery favours its contraction: this physiological fact explaining the practical,—that on the free opening of a wound, hæmorrhage so often ceases never to return. Exposure of artery and the application of cold.

Pressure upon the end of a wounded artery favours coagulation in the vessel, and the value of *acupressure* rests mainly upon this principle, as the pins mechanically arrest the flow of blood, whilst coagulation is taking place in the vessel up to the first branch.

When a ligature is applied to an artery the inner coats are usually more or less regularly divided, and the outer is so constricted as to arrest the current of blood through the vessel. The blood thus arrested consequently coagulates and forms a clot or thrombus, which is, as a rule, conical with its base towards the ligature and apex pointing to and reaching the first branch. (Fig. 118 *b*.) This clot subsequently contracts and becomes organized. The inner and middle coats, from their divided edges, pour On the action of ligature.

FIG. 118.



Effects of carbolised catgut ligature on common femoral artery, taken from a girl æt. 19, who died on the 20th day from gangrenous leg after the application of the ligature to the artery for elephas. The ligature in this case was firmly attached to the vessel, and had acted upon its coats as a permanent ligature.

out (*c*) plastic lymph, which heals the wound, and eventually cements the outer and inner coats, which with the clot unite together into one homogeneous mass; and if in the sequence of events nothing occurred to interfere with the steady evolution of this reparative process all would indeed be well, but unfortunately such is not the case, for the ligature, when composed of silk, hemp, or wire, and called permanent, has to come away. To this end the outer coat of the artery where constricted, must slough or ulcerate, and the vessel itself, in either case, at the line of ligature thus becomes divided. By such action, therefore, what nature might have well done by the processes already described too frequently becomes undone, and unless a firm clot has filled both ends of the artery, or plastic lymph become organized around the divided coats, the probability that secondary hæmorrhage will take place is very great. It is this fact which makes the practice of arresting hæmorrhage by means of the permanent ligature so unsatisfactory. To Stilling and Dr. J. F. D. Jones we are indebted for most of our knowledge on these points.

Mode of separation of permanent ligature.

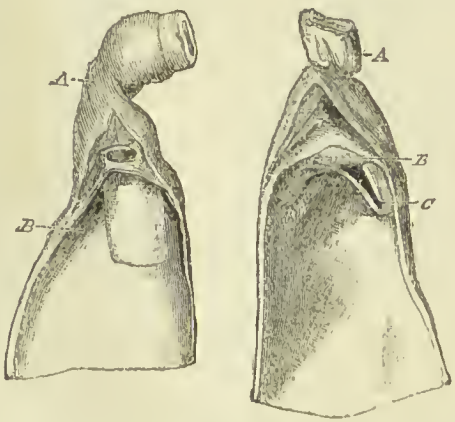
Of the catgut ligature.

When, however, the carbolised catgut ligatures are employed, the secondary changes which have been described do not of necessity occur, although in their primary effects the catgut ligature acts precisely as the permanent (*vide* Fig. 118; 'Trans. of Clin. Soc.,' 1878). The carbolised catgut ligatures are to be regarded as temporary ligatures, which may either dissolve within a few days of their application or become loose. If, therefore, an artery to which such a ligature has been applied does not become permanently closed by natural hæmostatic processes before the catgut ligature has dissolved or become loose, the circulation through the vessel may be restored or secondary hæmorrhage may ensue; this accident has occurred in my own practice. The catgut ligature is not, therefore, so safe as torsion for divided arteries. It is, however, a safer ligature than the silk or hempen, as it does not, like the latter, of necessity require an ulcerative process for its discharge.

Effects of torsion.

When an artery is closed by what is termed Torsion the inner coats

Fig. 119.



Effects of torsion upon an artery, showing the incurvation and laceration of the inner coats. From paper by the author, 'Med.-Chir. Trans.,' 1868.

are ruptured (Figs. 119 B and C), and the outer (A), when not twisted off, closed by the twists to which it has been subjected. But the inner coats, instead of being simply divided in a linear manner, as occurs when the ligature is used, become ruptured, separated from the outer coat and incurved, their divided ends turning into the vessel, and in the most perfect examples forming complete valves, not unlike the semilunar valves of the heart. The blood, which is consequently arrested by this valvular incurvation of the inner tunic, undergoes changes precisely similar to those already described. Plastic lymph is poured out by the divided tunics in the same way as has been shown in the application of the ligature, and it acts the same part in cementing all the arterial tunics and clot together. Between the two forms of practice, however, there is this difference, that where the ligature has been used, ulceration of the vessel is necessary to allow of its escape, and this may undo all that Nature has done to seal the artery and prevent hæmorrhage; whereas, when torsion has been efficiently performed and the hæmorrhage arrested, no subsequent action is liable to undo the good work that has been done or hinder the permanent closure of the vessel.

With both ligature and torsion, natural hæmostatics are aided in their work; but with the former the ulceration set up by the ligature may materially interfere with the perfection of the process; while with the latter there is nothing to prevent the process going on to its completion.

On Hæmorrhage and its Treatment.

On hæmorrhage.

When bleeding takes place rapidly from a wound after an injury or operation, it is called *primary;* when it occurs within twenty-four hours or in rare cases within two days, it is called *recurring or intermediary*, and, when after a lapse of a longer period, *secondary*.

Primary. Recurring.

The *primary* is due to the direct injury of the vessel; the *recurring* to the increased force of the circulation during reaction, and the displacement of clots that were sufficient to seal vessels when the circulation was feeble; to the overlooking of a vessel during the dressing of a wound, or, to some imperfection in the mode of securing it at the time of operation.

Secondary.

The *secondary* is caused by the giving way of an artery or vein; by ulceration of the ligature; by sloughing of the vessel alone or with the tissues around; by the accidental separation of a ligature; injury; or owing to the hæmorrhagic diathesis.

Symptoms of external hæmorrhage.

When blood escapes from a wound externally or into a cavity, the term *hæmorrhage* is applied; when beneath the integuments or amongst tissues, *extravasation* or *effusion* is said to occur.

The symptoms of external hæmorrhage require no description; the slow flow or the sudden gush of the life's blood being recognisable by all.

Concealed hæmorrhage.

Those of concealed, internal hæmorrhage or extravasation require, however, some attention. They are those of local injury, *plus* those general symptoms which denote hæmorrhage generally.

Bell's description of dying by hæmorrhage.

"In slow and in sudden hæmorrhages," wrote John Bell seventy years ago, "the symptoms are very different. In the former the patient is very slowly exhausted; at each return of bleeding the patient faints, and is laid in bed, and the cold applications and the fainting save his life. He rises, after some days, pale, languid, and giddy. The pulse flutters, and is hardly to be felt; the breathing is quick and anxious, accompanied with sighing and great oppression; the heart palpitates

on the slightest motion; and the slightest inclination of the head, or rising suddenly from the couch, endangers fainting. The voice is low; the eye is languid, colourless, and of a pearly white; the flesh feels soft and woolly, and the skin is pale, yellow, gelatinous, and, as it were, transparent, like modelled wax. After this stage of weakness the blood loses its colour; from this time forward it is a bloody serum only that distils from the vessels; dropsy appears, and the slightest loss of blood proves fatal. But when the patient expires suddenly by an impetuous bleeding from some great artery; when he dies of the bleeding from a femoral aneurism; when he is wounded among the viscera, and some great vessel is pouring out blood, the blood in the general circulation, in place of being forced onwards by the contractions of the arteries, runs backwards towards the wound from all parts of the body. The arteries no longer push on the contents of the veins; the blood ceases to flow towards the heart; the heart ceases to act; and the countenance assumes, as in asphyxia, a livid hue from want of circulation. The face becomes all at once deadly pale, the circle round the eyes is livid, the lips are black, and the extremities are cold. The patient faints, revives, and faints again; with a low and quivering pulse; he is sick; and his voice is lost. There is an anxious and incessant tossing of the arms, with restlessness, which is the most fatal sign of all. He tosses continually from side to side; his head falls down in the bed; he raises his head at times suddenly, gasping, as it were, for breath, with inexpressible anxiety; the tossing of the limbs continues; he draws long convulsive sighs; the pulse flutters and intermits from time to time, and he expires. The countenance is not of a transparent paleness, but of that clayey and leaden colour which the painter represents in assassinations and battles; and this tossing of the limbs, which is commonly represented as the sign of a fatal wound, is indeed so infallible a sign of death that I have never known any one recover who had fallen into this condition." ('Principles of Surgery,' vol. i, page 143.)

This sketch is so graphic that I have extracted it as a whole. Since my student days, when I first read it, it has been fixed in my memory. It is, however, only a page out of the work of a master surgeon which still deserves close study. A patient may lose a large quantity of blood and yet rally. Children bear the loss of blood badly, yet rally quickly. In old age a small hæmorrhage is of grave importance, the rallying power being very small.

Local treatment of hæmorrhage.

Hæmorrhage from any vessel, however large, is readily controlled by the application of well-applied direct pressure *upon the wounded part*, consequently any surgeon on being called to a case of wounded artery, having cleansed the wound and exposed the vessel, should put his thumb or finger on the bleeding orifice and check the flow. No mere covering up of the wound to smother the hæmorrhage will be of any benefit. When moderate bleeding comes from a wound and its source is unknown, whether arterial or venous, the first duty of the surgeon is to *clean the wound and remove clots*. This act alone is often sufficient of itself to arrest bleeding, not only for the time but permanently. The parts at the same time should be elevated and left exposed for a few hours.

When the bleeding is venous, *the elevation of the limb* has a most beneficial and rapid action. In amputations, before the application of

the tourniquet, as well as after its removal, the limb or stump should always be elevated for a few seconds to empty the veins. When well applied, *direct pressure* stops the flow of blood, and when such means appear to be sufficient for the treatment of the case, care should be employed in its application. The first pad to be applied to the bleeding part should be small and compact, corresponding in size to the last joint of the thumb; a larger one should be placed over it and carefully adjusted, and a third covering in the whole. These are to be firmly bound down over the bleeding vessel with a bandage or some unyielding strapping, care being taken that the pressure employed is sufficient to control the bleeding, but not enough to arrest wholly the circulation through a limb, thereby producing gangrene of the parts below. Direct pressure.

When direct pressure is inapplicable, *indirect pressure*, as it is called, or pressure by means of a tourniquet applied to the main artery of a limb above the wound, may be employed; and in operations upon the extremities, this is the best mode of preventing or arresting hæmorrhage, the tourniquet being accurately applied over the main artery, but not screwed up till the operation is about to be commenced. Indirect pressure.

For mere temporary purposes, the main artery may be compressed by the finger of the surgeon or of a skilled assistant; but for a lengthened period, this method is untrustworthy, it being impossible for any ordinary man to maintain firm pressure upon a vessel for more than a few minutes consecutively. The use of the weight as shown in Fig. 131 may be recommended. As a temporary means of arresting bleeding, however, manual pressure is of immense value, and should be applied to the femoral artery below Poupart's ligament for the lower extremity; and on the inner side of the biceps muscle for the upper, the fingers or thumb of the surgeon being employed according to convenience.

In recent times, what is known as Esmarch's method of arresting hæmorrhage has met with considerable support. It consists first, in applying an elastic bandage from the extremity of the limb to be operated on to a point above the site of the operation, and secondly, in the application of an india-rubber band or tube, tightly above the upper border of the elastic bandage, which can then be removed. By this method, the parts below the band have been rendered bloodless, and the surgeon may explore a limb, excise a tumour, joint, or bone, and even amputate, with the loss at the time of a spoonful of blood. Esmarch's method.

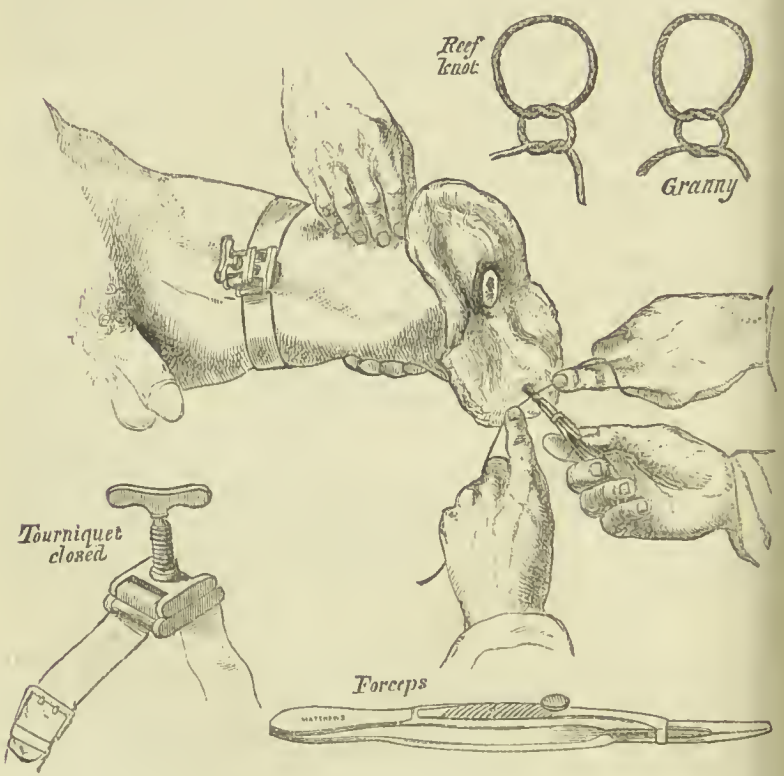
The method has, however, one objection, which is that when the band is removed blood oozes from the soft parts to a far greater extent than under other circumstances, the smaller vessels apparently becoming paralysed by the compressing bandage, or, from their having been completely emptied. The operation which is bloodless during the cutting process is, on the whole, therefore followed by the loss of as much blood as generally follows other methods. For amputations, I never employ now the compressing bandage, but elevate the limb to empty it of venous blood, and, with the hand press the blood upwards. I then use the elastic band or india-rubber tube as a tourniquet, having found by this method that all the advantages of Esmarch's plan are secured with less of the disadvantages. For exploratory operations and the removal of small foreign bodies, excision of joints, and Objection to method.

removal of necrosed bone, the compressing bandage has, however, great advantages.

The tourniquet.

The tourniquet is, doubtless, an excellent instrument for the compression of an artery, and J. L. Petit's is, probably, the best for the extremities. It should be applied to the limb directly over the vessel to be compressed, the pad being adjusted in the axis of the vessel. The ends of the band are then made to pass round the limb, and are secured either by a buckle or a knot, the former being preferable. The two plates can then be separated by the rotation of the screw, and a sufficient amount of pressure employed to stop the current of blood, and no more. (*Vide* Fig. 120.) Lister has invented an admirable tourniquet for compressing the abdominal aorta, and many others have been constructed, but these are ample for all ordinary purposes of arresting or preventing hæmorrhage.

Fig. 120.



Substitute for tourniquet

When a tourniquet is not at hand, as in the field, a stone or any hard substance may be rolled up in a handkerchief, applied over a vessel, and bound round the limb; the ends of the handkerchief too should be attached to a stick or sword, any amount of compression being obtained by simply twisting them.

As *temporary* means of arresting hæmorrhage, therefore, pressure upon the bleeding spot, *i.e. direct*; or upon the main artery of the part, *i.e. indirect*; digital or instrumental is the more reliable. The wound

in both cases should be well exposed and cleansed, and all coagula removed preparatory to the application of such permanent means as may be at command. Of these, the *ligature, torsion,* and *acupressure* are the chief. Styptics and the cautery are only employed when the three means mentioned are either inapplicable or have proved unsuccessful.

On the use of the Ligature.

On the use of the ligature.

Since Ambrose Paré re-introduced the use of the ligature (1550), it has been the favourite means for the arrest of hæmorrhage; the speedy way in which bleeding from an artery, however large, is checked by its application, and the feeling of relief experienced on knowing that for a time, at least, all fear of bleeding has been removed, having so influenced the majority of practitioners in its favour, as to induce them to put aside, untried, all other suggested means as being unnecessary. It took, however, more than two centuries for the ligature to become established in practice; in fact, its adoption was not general till Jones had demonstrated by his experiments already alluded to (p. 413), the physiological processes by which hæmorrhage is naturally arrested in a bleeding vessel, and, that by the ligature, these were utilised.

Mode of ligaturing.

To tie an artery efficiently, the vessel should first be taken up cleanly and drawn out. A smooth round cord of silk, hemp, or catgut, must then be applied firmly around its extremity, sufficient force being used to cause rupture of the inner coats of the vessel (such a result, although desirable, not appearing, however, to be constant); and occlusion of the outer coat, a knot called the surgeon's or sailor's reef-knot being employed. In forming the knot, the loop of the ligature should be pressed down to the artery by the finger or thumb as indicated in the drawing (Fig. 120), otherwise the extremity of the artery will be liable to be broken off, particularly if diseased.

When the vessel is deeply placed and cannot be isolated, it must be ligatured with some of the adjacent tissues. When it is so embedded that its free end cannot be taken up with forceps, a tenaculum may be passed beneath the bleeding vessel and all the tissues taken up by the instrument should be strangled by the ligature. The ends of the ligature may be left hanging out of the wound. In later years Mr. De Morgan has been in the habit of cutting off both ends of the ligature, leaving the knot in *situ* and closing the wound, such a practice being a revival of the last century, and, since carbolised catgut ligatures have been employed, the practice has become general.

De Morgan cuts off both ends.

Ligature of diseased arteries.

When the vessels are diseased and brittle, some care is needed in the application of the ligature. The vessel should not be tied too tightly lest too much of the artery be torn and the ligature be made to separate before natural hæmostatics have closed it. Some have suggested the use of a flat ligature under these circumstances, but it seems scarcely needed. In 1865, I was called upon to apply a ligature to the femoral artery of a man over seventy years of age for femoral aneurism. The vessel was so brittle that I felt the coats give way on the application of the ligature; the included tissue too seemed so thin that I expected to find the ligature come

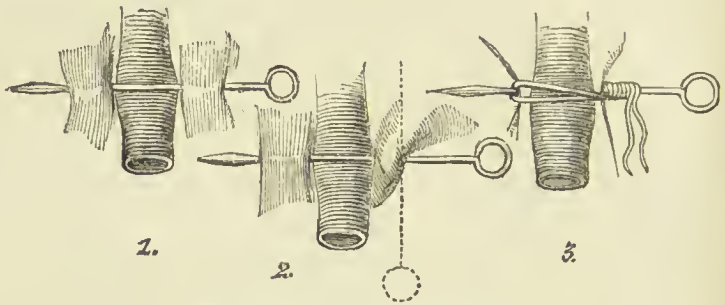
away in my hand, which did not occur. The case ultimately did well, and no bleeding ensued.

Acupressure.

On acupressure.

The late Sir James Simpson brought this method of arresting hæmorrhage before the profession in 1860, and on his authority many resorted to the practice. Drs. Keith and Pirrie, of Aberdeen, have given it their warmest support; indeed, at the present time, in Dr. Pirrie's hands it is alone employed as a general way of arresting hæmorrhage. The principle of the practice is very simple, viz., the occlusion of the artery by the temporary pressure of a pin, without

Fig. 121.



Different modes of applying acupressure.

lacerating the vessel or setting up inflammatory and suppurative action as in the ligature. The pin is removed on the second or third day, according to the size of the artery. The advantages thus claimed for it are very great, but experience has not yet decided in its favour. There are three leading forms of acupressure.

In the *first*, the artery is directly compressed between the pin, which crosses its free end, and the muscle beneath. (Fig. 121, 1.)

In the *second*, the same result takes place, the pin being made to give a half twist through the tissues between its first and second insertions. (Fig. 121, 2.)

In the *third*, the pin is simply passed beneath the vessel and pressure applied to the artery by means of a loop of wire or silk looped over its point and made to cross the vessel, the ends of the loop being secured upon the shaft of the pin. (Fig. 121, 3.)

Its value and drawbacks.

The *good* point in acupressure is the absence of any foreign body for more than a few hours or days. Its disadvantage lies in the fact that its success depends upon the coagulation of the blood in the vessel down to the first branch, one of nature's temporary hæmostatic processes, and not upon the permanent closure of the coats of the vessel. As a consequence it is not so secure as the ligature, or physiologically so sound as the practice of torsion. As a general mode of arresting hæmorrhage it seems improbable that it will hold its ground, indeed it is but little practised at the present time. As a mode of temporarily arresting hæmorrhage in certain cases where the ligature and torsion are inapplicable, as in wounds of the palm or the sole of the foot it is indeed valuable, and particularly also as a means of arresting the flow of blood from a leech bite or other bleeding point—

the passage of a needle through the skin, and a figure-of-8 ligature over, being of great service.

An ingenious modification of this process has been devised and successfully used by Mr. Dix, of Hull. A wire passed through the flaps by means of two needles and twisted over a cork outside, compresses the bleeding vessel in the same way as the needles. It is called by its author "the wire compress," and is fully described in the 'Edinburgh Medical Journal,' Sept., 1864. It seems, however, to be more adapted for securing an artery in its continuity as in the treatment of aneurism, under which head (see page 449) it will be described in detail. Dix's method.

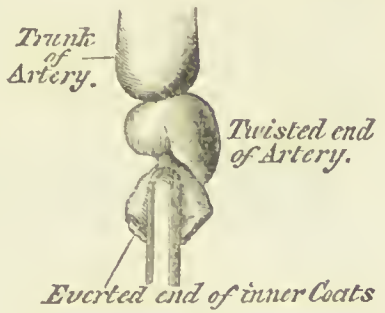
On Torsion.

On torsion.

In a physiological point of view there is no method more perfect at command for the control of hæmorrhage than that of torsion; because, unlike acupressure, which uses one only of Nature's hæmostatic processes, or the ligature, which is a foreign body in a wound, and becomes a source of danger by undoing at a later what has been done at an earlier period of the case, it utilises to the utmost all the physiological processes employed *by* Nature to prevent and arrest bleeding, and places the vessel in the most favorable position for them to take effect. What these changes are was discussed in a former page of this chapter.

For the application of torsion a good pair of forceps is required (*vide* Fig. 120), that will hold the end of the artery firmly, that has no lateral motion, and with serrations blunt enough to obviate any laceration or cutting of the parts seized by the blades. The vessel should then be drawn out, as in the application of the ligature, and three or four sharp rotations of the forceps made. In large arteries such as the femoral, the rotation should be repeated till *the sense of resistance has ceased*. The ends should not be twisted off. In small arteries the number of rotations is of no importance, and their ends may be twisted off or not, as may be preferred. In Fig. 122, the appearance of a femoral artery sufficiently twisted is well shown. Mode of performing torsion.

Fig. 122.



Effects of torsion on femoral artery.

When the vessels are atheromatous or diseased fewer rotations of the forceps are required, the inner tunics of the vessels being so brittle as to break up at once and incurve. If the surgeon, therefore, twist more, he will break away the external or cellular coat which is not only of essential importance in maintaining the lacerated inner coats in position, but in allowing blood to coagulate, and lymph to organize between them. With this caution diseased arteries appear to be as amenable to the treatment as the healthy, and torsion requires no more care under these or any circumstances than the application of a ligature. The diseased vessels.

Arguments in favour of torsion.

The physiological arguments in favour of torsion are numerous, while the practical advantages seem to be not less. After nine years' experience of the practice among vessels of all sizes (the femoral being the largest) I have had no mishap. I have further observed, that wounds have united more rapidly and kindly—primary union being the rule; there has been less constitutional disturbance after operation and consequently less liability to traumatic fever, pyæmia, and other complications such as we are all too familiar with, in the practice of surgery. Stumps have healed in a week, and patients been up in two weeks, without one single drawback, rapid and uninterrupted convalescence following the operation. In other cases, equally good success can be recorded. At Guy's Hospital we have had two hundred consecutive cases of amputation of the thigh, leg, arm, and forearm, in all which the arteries had been twisted (110 of them having been of the femoral artery) and no case of secondary hæmorrhage.

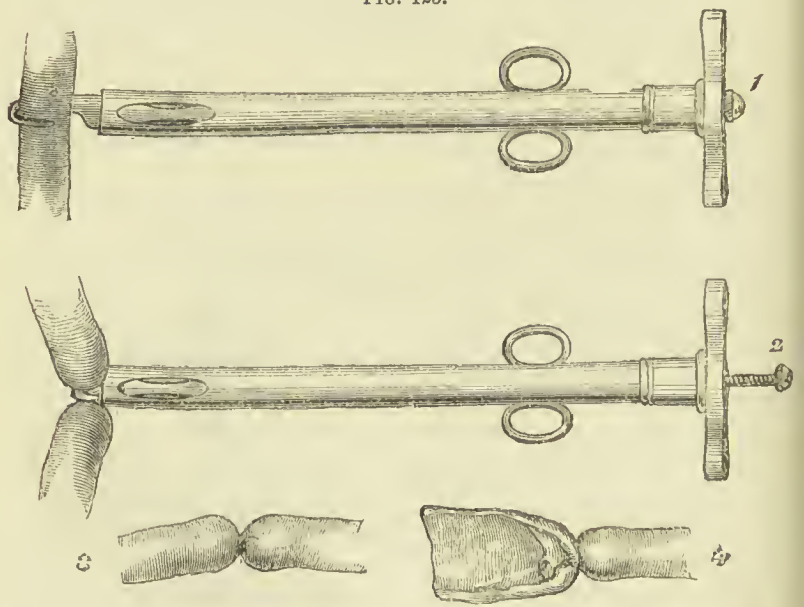
Statistics of torsion.

The artery constrictor.

The Artery Constrictor.

Dr. Fleet Speir, of Brooklyn, New York, has had an artery constrictor

Fig. 123.



1. An artery taken up by the constrictor. 2. Artery constricted. 3. Effects of constriction upon vessel. 4. As seen when laid open.

How it acts.

made (Fig. 123) which, as he has demonstrated upon both the living and the dead, has the power of dividing the inner coats of an artery and allowing them to recurve, as in torsion. He has used it on all the larger vessels except the iliac and subclavian, and has never had any trouble, union chiefly by first intention having followed ('Med. Mirror,' New York, April, 1871, and 'Archives of Clinical Surgery,' Sept., 1876).

The instrument he recommends (Fig. 123), should be "tight-fitting

enough to constrict thoroughly, and yet grooved and smooth enough *not to lacerate* the external coats, while it makes a *complete invagination* of the inner coats. For operating upon vessels in continuity, as for aneurism, I prefer to place the limb, after constriction, in a relaxed position, so as not to stretch the vessel after being constricted."

In Fig. 123 the instrument is shown applied to an artery, and in Fig. 123 (4) a section of the artery, subsequent to its constriction. I have tested this instrument on the living, and have made a large number of experiments on the dead, and find it does all that Dr. Speir asserts. I believe it to be of value for obstructing arteries in continuity, as it does for such precisely what torsion does for divided vessels.

Other Methods.

On styptics and astringents.

Astringents or styptics are also valuable agents in the arrest of bleeding, when the means previously mentioned are inapplicable, their value being much increased when combined with pressure. The perchloride or persulphate of iron, pounded matico, alum in powder or solution, applied to a bleeding surface on a pad of lint or dossil of cotton-wool, and bound on, are the best applications; though tannic acid, Ruspini's styptic, or oil of turpentine, are also serviceable. Before applying any of these, the bleeding part should be wiped as dry as possible, and all coagula removed. In uterine surgery, injections of some of these astringents are much used. In rectal surgery, the bowel may be plugged with lint or sponge saturated with a styptic, and in epistaxis the nose may be plugged with the same.

Cold is a powerful styptic, cold air often permanently arresting even copious hæmorrhage on laying open a wound. A stream of cold water directed to a bleeding part, or ice pounded and placed in bladders or bags, and laid on bleeding wounds, are at times of great assistance.

On cauterization.

Cauterization, although the common mode of arresting bleeding by the ancients, is now seldom employed; yet is it a valuable agent in cases where neither torsion, ligature, nor acupressure, is available. In spongy tissues from which blood is oozing, or even in other cases, the hot iron will often act most beneficially. It may be applied through iron buttons or cones brought to a *black heat* by means of fire, or through platinum or porcelain instruments, heated by means of gas or the galvanic battery. In both the heat should be enough to cause a dry eschar upon the bleeding part, while care should be exercised subsequently not to remove this too soon; indeed, the eschar or scab should be left for natural processes to throw off. The cautery in no case should be too hot, that is, *red hot*, as it destroys the vessels too much, but would be of a *black heat*.

Capillary hæmorrhage

Hæmorrhage from the *capillaries* or small vessels, rarely takes place to any dangerous extent, unless it occurs in "bleeders," or such as labour under the hæmorrhagic diathesis. It has always a tendency to stop by itself through the natural hæmostatic processes such as have been described. If, however, it be too persistent, the surface of the wound would be exposed and cleansed, the stimulus of the air being often sufficient to excite closure of the vessels. Moderate pressure

upon the surface of the wound, or a stream of cold water over it are also valuable auxiliaries.

Summary of the treatment of hæmorrhage from wounded vessels.

By way of summary, the following conclusions may be arrived at *for the treatment of hæmorrhage from wounded vessels.*

All arteries, whether divided or wounded, from which blood flows, are, if possible, to be twisted or tied at the seat of injury; and to accomplish this, when room is required, the wound may be enlarged. *Both ends of a divided* artery are to be dealt with separately. When an artery is wounded John Hunter's advice is still sound, "First apply the tourniquet, then lay the artery sufficiently bare, and tie the vessel above and below the wounded part," MS. Lect., 1787. In some cases, the vessel had better be completely divided, and its two ends twisted. I have followed this practice with the brachial on three occasions, with good result, and advise its adoption in all arteries of less calibre.

When no bleeding is present, no operation as a rule is required; although, in exceptional cases, this may be deviated from, as when a renewal of the hæmorrhage endangers life.

When *moderate* arterial hæmorrhage exists and the artery cannot be taken up in the wound without an operation, the graduated compress may be employed with a fair chance of success; but should it fail, the vessel must be secured.

When arterial hæmorrhage endangers life and the artery cannot be treated at the wound, the trunk of the vessel is to be secured above the wound.

When *recurring* hæmorrhage is severe, the wound is to bereopened or enlarged, all clots turned out, and the vessel tied or twisted. When moderate, it can be treated by elevating the part, by pressure over the main trunk of the vessel or the wound, and by the application of cold, such as the ice-bag.

At times all bleeding ceases on the mere exposure of the open wound; at others there is merely a general oozing. Under these circumstances, if exposure of the wound to the air, or to a stream of cold water fails to check it, well-applied pressure will often suffice. In exceptional cases, styptics may be required.

Treatment of secondary hæmorrhage.

Secondary hæmorrhages are to be dealt with in the wound as primary, that is, when bleeding is profuse, the artery is to be re-ligatured or twisted at the bleeding point; when not severe, it will probably be restrained by pressure and the elevation of the part; as in a general way, when secondary hæmorrhage takes place after the application of a ligature to a wounded artery, the bleeding comes from the lower end of the vessel. Guthrie has clearly shown, that repair is less perfect in the lower end of a divided vessel than in the upper, less contraction and retraction of the vessel, less perfect coagulation of blood, and, effusion of plastic lymph.

Venous hæmorrhage.

Venous hæmorrhage, unless from the trunks of large veins, quickly ceases, usually from the collapse of the veins. Where any impediment exists to the return of blood from the wounded part it may prove, however, troublesome, yet its arrest will probably be secured on the removal of the obstruction. The elevation of the wounded part will tend much towards this end, as will also the application of cold, or firm pressure upon the spot.

Division of large veins.

When large veins are divided and the bleeding is copious they must

be tied or twisted. A small opening into a large trunk may be closed with a fine ligature, leaving the main canal free, as wounds of veins heal rapidly, such as after venesection.

Injuries of the large venous trunks, however, are of grave importance, and any wound or injury that induces, directly or indirectly, the complete arrest of the venous circulation through one of these, is probably of greater consequence than the wound of an artery. The internal jugular vein, too, may be tied with success.

A vein is known to be opened, when black blood flows from the wound in a steady stream and from its distal part, when pressure above the wound increases the flow and pressure below retards or stops it.

Phlebitis is the chief evil to be feared from an injury to a vein, and when it occurs, it is very fatal. Veins, however, will doubtless bear much more manipulation than our forefathers believed, without any such danger ensuing. Phlebitis.

The entrance of air into a wounded vein is likewise a source of great danger; but the subject will receive attention in a succeeding chapter. Air in veins.

The general treatment of hæmorrhage

On the general treatment of hæmorrhage.

is of importance, though subsidiary to the *local*. When *syncope* takes place as a result of loss of blood, the surgeon should not be too hasty in attempting to overcome it, as it is without doubt one of the most valuable means which Nature employs to check bleeding and to assist natural hæmostatics; but at the same time, great care is needed that the syncope be not fatal. If such an event appears imminent, the patient should be kept in the horizontal posture with the head low; cool air should be allowed to blow upon the face, or cold water sprinkled over it; some diffusible stimulant, such as ammonia, ether, chloroform, or the nitrate of amyl, may be inhaled, or brandy given in small quantities. In extreme cases some surgeons advise pressure being made upon the abdominal aorta or large arteries, to confine the blood to the nerve-centres; or, even transfusion may be employed. This operation, however, has never been in high favour with surgeons; from accoucheurs it has received considerable support, the late Dr. James Blundell having given it his energetic advocacy. When attempted it should not be delayed until too late or when the hope of rousing the nervous and circulating systems has become almost forlorn. Under all circumstances, plenty of bland liquid nourishment should be given, such as milk, eggs, broths, &c., and stimulants in moderation. When there is a prospect of a recurring hæmorrhage, all food should be given cold. In the convalescing stage, iron and quinine, ammonia and bark, are of the greatest value. Opium is a drug that must not be forgotten, as in the restless stage of bloodlessness its action is most beneficial. It must, however, be administered with caution, for with a feeble heart large doses are apt to depress. Half-grain doses repeated at intervals are probably the safest; larger, however, may at times be given. When capillary bleeding takes place to any extent after an operation, a full dose of opium, say a grain, is often very valuable. Syncope.

When the hæmorrhagic diathesis exists, iron in full doses is of great service, the tincture of the acetate or perchloride in half-drachm doses

being the best. Oil of turpentine is likewise a valuable remedy, twenty miuim doses being sufficient for an adult. Gallic aeid in ten-grain doses, and acetate of lead in one-grain doses, are also beneficial, and all these act upon the blood and dispose it to coagulate.

Tranfusion.

Transfusion.

When Dr. Lower, of Oxford, with Sir E. King, in 1665, first praetised transfusion, blood was drawn from an artery and conducted *directly* by means of a tube into the vein of the patient, the blood being propelled simply by the force of the circulation of the emitter. As time progressed, the inexpedieney of opening an artery was felt, and the plan of transmitting blood from vein to vein came into use. In 1785 this plan was also warmly advocated by Dr. Harwood, of Cambridge. With this change of practice, the mode of operating had to be altered, because the force of the venous circulation was found to be insufficient to propel the blood. The *indirect* or *mediate* mode of operating consequently came into use, the blood of the emitter being received into a vessel and transmitted by a tube or syringe into the vein of the patient. To James Blundell is due undoubtedly the credit of having devised an apparatus by which the operation can be efficiently performed. He called it first an "impeller," and when improved, a "gravitater" ('Lancet,' 1829). Since his time Drs. Aveling, Hewitt,[1] Braxton Hicks,[2] and particularly Roussel, have done much towards rendering the practice more safe and certain. The object of the surgeon in the operation is, to transfuse blood from a healthy into a bloodless patient, and his aim should be to prevent the coagulation of the healthy blood during the operation, as well as to guard against the introduction of air into the veins. This operation should only be undertaken when a trustworthy apparatus is at hand, and of these Dr. Roussel's is without doubt the most complete. Aveling's, however, is excellent.

Roussel's instrument.

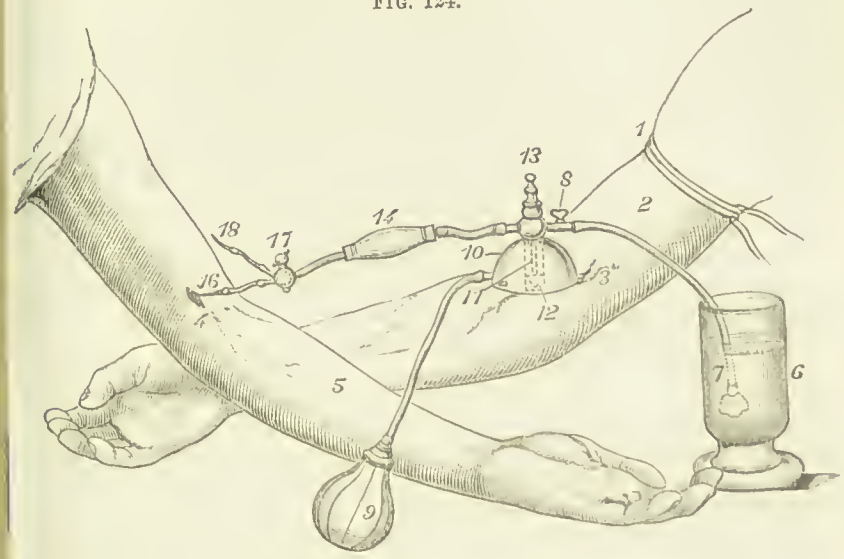
Dr. Roussel's instrument is made of hardened pure caoutchouc; it is composed of a tube with a Higginson's syringe large enough to contain two and a half drachms of fluid (Fig. 124) (14) in its course. One end of the tube is attached to a rigid cylinder (10), open at each end, and applied over the seat of the vein required to be punctured (3), which has been obstructed by the band (1). The cylinder is fixed in position in being surrounded by a rigid cup which can be exhausted by an elastic pump (9) in connection with it. The exhaustion of this cup not only fixes the apparatus to the arm, but also increases the turgidity of the vein over which it is applied. The cylinder within it (11) is then closed by the introduction at its upper extremity of a lancet (12), the exact depth of which can be regulated (13). Before operating, the air should be driven out of the cylinder and tube by filling them with tepid water (6), in which a little bicarbonate of soda may be dissolved by means of the syringe (9), and the tube (8, and 7), which is attached to the cylinder opposite to the conducting tube (17). When about to operate the lancet (12) is depressed into the vein.

To the extremity of the conducting tube a stopcock (17) with two canulæ (16 and 18) is attached, the stopcock being inserted to direct the flow of fluid into one or other of the canulæ. One of these canulæ is introduced into the vein of the recipient (5). The apparatus

[1] 'Obstet. Trans.,' 1865. [2] 'Guy's Rep.,' 1868.

(10) being filled with water, the vein is opened by the lancet and the contents of the cylinder and tube pumped out through the free cannula (18) until blood only flows through it. The stopcock (17) is then turned and the blood is injected into the patient's arm through an opening in the vein (4). The syringe by this apparatus "forcing the blood into the vein of the recipient by degrees as it draws it from the

Fig. 124.



Dr. Roussel's injecting apparatus.

vein of the donor, every particle of it having remained less than a second out of the human vessel, enclosed in a full tube, and the blood conducted by an artificial vein and heart, hermetically closed, damp, warm, and soft as are the human vessels. The blood is not modified as regards its fibrine, globules, gas, temperature, or density; it passes from one system to another with all its primitive vitality, and continues to live on."

Not more than six to nine ounces of blood should be transfused at one time, the injection too should be gradual, that is, about six syringefuls a minute.

DISEASES OF THE ARTERIES.

On arteritis and atheroma.

Arteritis.—Under this heading, besides the rarer forms of disease, we shall include atheroma, as there is no longer any question of its inflammatory nature. Of this, Virchow, Billroth, Wilks, and Moxon, have given sufficient evidence, though in modern text-books the old view is still taught, and the weight of Gulliver's investigations ('Med.-Chir. Trans.,' vol. xxvi) has not yet lost its influence. We by no means think that Gulliver was altogether in error in holding that atheroma was a fatty and calcareous degeneration of the inner and middle arterial coats with subsequent thickening of the adventitia; on the contrary, it is not improbable that atheroma may sometimes be a simple retrograde metamorphosis of the arterial tissues; but, there can be no doubt that it more often begins as a sub-inflammatory pro-

cess. This conclusion has been reached partly upon histological grounds and from the fact that the disease is most prone to occur where the wear and tear is greatest, and inflammation, consequently, most likely.

Forms of arteritis.

Arteritis is usually described as "acute" and "chronic," and it will be well for us to adopt the terms in general usage. But the student must remember that the pathologist applies the one to a process the product of which is cellular or nuclear; the other, to that which shows organized or tissue product, or some degenerative change such as the calcareous, which must necessarily have taken some time in its production. From a clinical point of view both terms are more arbitrary than exact, and there is other evidence than pathological to show, that changes, judged by such a standard to be chronic, are rapid in their course, and, in the same way others which must be called acute, in that microscopically they are cellular, are not necessarily of short duration. If we, then, continue to describe arteritis as acute and chronic, it is evident that no strictly histological basis is broad enough for accuracy, and we have therefore adopted that classification of acute arteritis which accords best with our own experience.

Acute arteritis is found under four conditions:—

Acute form.

1st. As slightly raised greyish or pellucid patches on the living membrane of the artery, which, when examined microscopically, show a multiplication of the cells of the superficial layers of the inner coat. It is a disease which is not, perhaps, of much importance when attacking the aorta or larger vessels, but, when it affects the visceral arteries, it may lead to a considerable diminution of their calibre, to thrombosis, and thus to all those changes which ensue when the circulation becomes arrested. It is a change of this kind which Heubner lately described in the vessels of the brain as particularly liable to occur in the subjects of syphilis; and, it is possible, though not yet proved, that a similar result may be induced in the larger arteries from the same cause.

2nd. As a general affection of the arch of the aorta, in which that vessel is greyish, softened, thinned, and dilated, but without any strictly atheromatous or calcareous change in it. It would be better perhaps to call this state, acute softening, though the nature of the process is essentially inflammatory.

3rd. As a local disease in the arch of the aorta in cases of acute rheumatism. This is rare, sometimes originating in the friction produced by large valvular vegetations which are washed backwards and forwards in the blood-stream, and sometimes without any such cause and apparently as a spontaneous arteritis. In either case, it is liable to lead to aneurism or imperfection of the aortic valves.

4th. As a local disease in the arteries, secondary to the lodgment of emboli, which, by their presence, set up an arteritis.

Chronic form.

Chronic arteritis may occur as a widespread and continuous disease in most of the arteries of the body, or as one which is localised to various parts, specially the larger vessels. Of the former, a very rare disease, examples have been published by Wilks ('Guy's Rep.,' 1869), and Savory ('Med.-Chir. Trans.,' 1856). The principal arteries of the body were thickened and obstructed, the vessels being filled with old clot that was "so closely adherent that the wall of the vessel would split rather than part from the clot. At both the ending and commencing

parts the clot was white and like fibrous tissue, and could not be distinguished from the coats, which here were swollen and atheromatous. The atheroma, indeed, appeared to be here in the clot also as well as in the arterial coat" (Wilks).

There seems little doubt also as to the fact, that a vessel may become completely obstructed by a strictly local arteritis. Obliterative arteritis.

It may be noted in passing, that the descriptions of the naked-eye appearances in these cases, exactly correspond with that of the so-called syphilitic disease of the cerebral arteries just alluded to as having been described by Heubner, and which has been classed by us as acute arteritis, inasmuch as it is a disease purely cellular.

Such cases as the last, however, are rare compared with those of local chronic arteritis, when met with in the arch of the aorta at its bifurcation and other parts. It is indicated by thickening of the vessel and loss of its elasticity, by the external coat changing into a tough fibrous tissue, and the affected parts, instead of feeling thin and pliable, becoming hard and leathery. "Now, such changes as these are commonly present along with the atheromatous pulp in the deep inner coat, and these are the part of the changes that go by the term atheroma as commonly accepted. Changes of a kind that cannot be regarded as other than inflammatory are present in nearly all bad examples of atheroma; the extent of the inflammatory changes generally surpasses that of the atheromatous, and these inflammatory changes occur often without any atheroma, and especially in younger subjects, about or under middle age. The more inflammatory changes tend more to produce aneurisms than do the atheromatous patches. When atheroma is thoroughly established, so that a pulpy mass is formed in the coats at any spot, this is generally thick and hard and unyielding, and does not give way to pressure so as to form an aneurism. The disease that leads to aneurism is the same disease as leads to atheroma, and I think it is a correct way of describing these relations to say that they are alternative results of the disease of the coats. I mean so that if the sub-inflammation is severer, then the coats are softened and yield early, before the thickening and stiffening chronic process that leads to the atheroma patch has time to occur. On the other hand, if the sub-inflammation is lower and slower, then there is not such softening at any time in its course as to lead to aneurismal yielding; but the result is a slow thickening, which reaches a considerable and a sufficient degree before any fatty degeneration occurs within it, and then always the thickening goes further than the granular change, so that the wall of the artery is rather stronger there than weaker; and if the sub-inflammation be yet slower and slower the fatty or granular change in the coat goes on to an accumulation of lime salts or petrifaction of the spot, the stone in the wall showing sometimes some rude bone-cells, so that ossification may be thought really to occur, though the bone is truly a very rough production, if it be bone at all. Now, if instead of being thus slow, so as to give time for the calcareous change of its products, the sub-inflammation be very acute, then the arterial wall may rupture, and either sudden death or a false aneurism be the result." "I might," adds Moxon, "give practically any number of cases and drawings, showing the active cell formation in cases of atheroma, this cell formation found in the deep layer of the inner coat especially, and causing the production of little nests of cells, in which fat and lime Moxon's views of diseases of the coats of arteries. Active cell formation in atheroma.

soon accumulate. In severer cases the middle and outer coats, and the deep layer of the inner coat, are seen to be charged with lymph-cells in enormous numbers, crowded together, and separating the proper elastic and the muscular fibres into little patches and shreds, while both elastic and muscular fibres fall into a state of fatty degeneration."—Moxon, 'Guy's Hosp. Rep.,' 1870–71.

In Figs. 125 and 125A, taken from drawings kindly made for me by Dr. Moxon, these changes can be seen. His description is appended.

Mechanical strain cause of atheroma.

Dr. Moxon and others believe, and I think rightly, that mechanical strain is the main cause of atheroma of the arteries. It is chiefly found at points where the strain upon the coats is greatest and in men who follow laborious occupations. Gulliver originally described it as a disease of the larger arteries, but it is now known to involve the whole arterial system.

In advanced disease calcareous plates are found in the larger arteries, while the smaller are converted into completely solid tubes. The vessels, moreover, alter in shape, and become tuberous as well as tortuous—dilatation taking place at the points of bifurcation. When the disease is

FIG. 125. FIG. 125A.

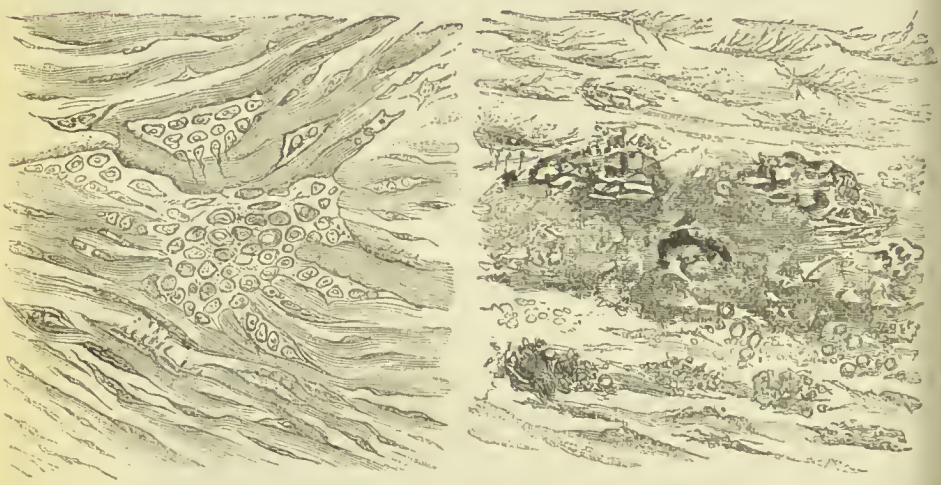


Fig. 125 shows the incipient inflammatory stage of the change in an artery which leads to atheroma, and in which aneurism usually occurs.

Fig. 125A shows the final degenerative stage of the same change in the artery which constitutes atheroma.

Fig. 125 is a small portion of a fine section of an artery from the neighbourhood of an aneurism; the artery was here soft and swollen, and had a more pellucid and bluish appearance than natural. A small and early patch of the disease is represented. The cells of the artery-wall are found enlarged, their nuclei multiplied, and at the centre of the patch they burst towards each other to make a cluster of cells derived from the multiplied nuclei.

Fig. 125A is taken from the same artery at another spot, when the coat had the well-known yellow appearance of atheroma. Here the patch of multiplied cells has degenerated to a heap of oily and earthy matter with some plates of cholesterine. The individual cells around are seen to be degenerated in the same way. Some of those at the upper part of the figure are, on the other hand, developing into elastic fibrils. This is a frequent accompaniment of the atheromatous process, and its effect is to ultimately strengthen the arterial wall at the diseased spot.

very extensive or advanced, the inner coats become destroyed and undermined with blood. When this takes place to any extent, what is

known as a *dissecting aneurism* may be produced; but in other cases the inner coat is so raised by the clot of blood behind it that the arterial canal becomes closed, and gangrene of the parts supplied by the occluded vessel may ensue. In a preparation in Guy's Museum (1465), the aorta was thus affected, causing gangrene of the extremities. In others, the vessel may rupture, and cause death from hæmorrhage. In rarer cases, the vessel may be completely closed by the calcareous disease, in some the roughened raised patches become the centres of fibrinous adhesions which may either cause occlusion of the vessel directly by their size, or, indirectly, by being carried into more distant arteries, as emboli. In both cases gangrene of the parts thus deprived of blood will be produced. *Senile gangrene* doubtless is occasionally caused in this manner. Thus it is seen that this atheromatous disease of the arteries is often the cause of gangrene of a part by direct occlusion of the vessel as well as by embolism. As a general rule, however, in those instances in which portions of artery are found to be withered and converted into fibrous cords, evidence is wanting of arteritis being the cause. Recent investigations tend to show too that such changes are the natural result of an obstruction of the vessel, and that this obstruction is probably due to a plugging of the canal by a clot, or to what is now known as an embolus.

Formation of dissecting aneurism.

Atheroma often a cause of gangrene.

Fatty degeneration of the inner, and a primary calcareous change in the *muscular* or middle coat of medium-sized vessels must also be mentioned. These may be and no doubt are mostly associated with chronic inflammatory changes in the arterial system, but there is also reason to believe that sometimes they are essentially primary degenerations which lead to contraction of the vessels and senile gangrene, as do atheromatous changes.

Embolism

is a somewhat common affection and consists in the occlusion of a vessel, large or small, by a plug of fibrin or calcareous matter, carried by the blood from some distant part, and, generally from the heart. The physician meets with it in cases of paralysis more or less complete, from the plugging of a cerebral vessel, associated with valvular disease of the heart, acute rheumatism, or aortic disease. The surgeon meets with it in certain forms of amaurosis and local gangrene, and, as a precursor of aneurism. The pathologist sees it in the fibrinous clots (infarcta) found frequently in the lungs, spleen, kidneys, or other organs.

On embolism.

Examples of the arterial form.

The symptoms of embolic occlusion of an artery are, sudden and severe pain in the part from which the circulation is cut off, the pain in some cases extending down the whole course of the artery; in others it is a local numbness; whilst tenderness is usually present in the course of the vessel. Symptoms of a deficient circulation in the part soon appear, such as coldness and pallor of the skin, which may go on to complete gangrene. All cases of embolic occlusion of an artery, however, do not end in death of the part, since in patients of good power the collateral circulation may become subsequently established and a recovery follow. In patients of feeble power gangrene is to be feared. In not a few cases, embolism leads to the formation of an aneurism.

Symptoms of arterial embolism.

A woman, æt. 47, who never had any illness, was seized in June, 1868, with a mild attack of hemiplegia on the left side, from which

Example of gangrene due to embolism.

she perfectly recovered in three weeks. She remained well and returned to her ordinary duties, those of a laundress, for three months, when, whilst kneeling, she suddenly felt a severe pain in the *right* leg, extending down the calf. This was rapidly followed by numbness and coldness of the leg, and discoloration. She was admitted into Guy's under my care, three days subsequently, with gangrene of the foot and lower two thirds of the leg. The pulsation in the femoral artery was normal, but no vessel could be felt below the thigh. I amputated the limb at the knee-joint on October 13th, twisting the popliteal and other arteries. Some sloughing of the stump followed, but recovery appeared probable, when acute bronchitis set in, followed by delirium and death. Dr. Fagge kindly examined this patient's heart before the operation and reported, "There is scarcely any evidence of cardiac disease, but I think that I discover a short presystolic bruit. If this is so the mitral orifice is probably contracted, and a clot formed on the valve, or in one of the heart's cavities, may have been carried into the artery of the lower limb." After death the mitral was found the size of a button-hole. Around its edge were recent vegetations, and one of them doubtless had been carried into the circulation, causing the gangrene, as another had caused the paralysis three months previously.

Many cases of senile gangrene are doubtless embolic, from the washing away of some calcareous fragment from an atheromatous vessel.

Hyperæsthesia of parts below the occlusion by embolus.

In some cases of occlusion of an artery by an embolus, after the application of a ligature, hyperæsthesia and increased temperature of the part below the seat of obstruction may be met with. These symptoms are clearly due to the influence of the nervous system and the congestion of the smaller collateral vessels.

Pulmonary embolism.

There remains to be considered, moreover, pulmonary embolism, a form which is important to the surgeon, not so much as a disease of the lung as because it is generally a sequence of some clotting or thrombosis as it is called, in the veins. This clotting is very common in all kinds of cases under treatment in surgical wards. We can hardly represent the case too strongly, and we know of no more important subject than this relation of thrombosis to pulmonary embolism. Whenever a patient undergoes prolonged rest in bed, especially if he be naturally weak, bloodless, or debilitated from any cause whatever; if the blood be over fibrinous as in lying-in women; whenever there is any surgical fever, and in other states too numerous to mention, there is a risk of clotting occurring in the *quiet* parts of the circulation, especially in the veins of the lower limbs and in those of the pelvis. The symptoms are often slight. If the clot be due to phlebitis, then there may be pain; if not, there may be no more than the slightest œdema about one ankle. This, however, is sufficient to put the surgeon on his guard, and, by the subsequent enforcement of prolonged rest, time is given for the adhesion of the plug to the vein wall, and pulmonary embolism is arrested. It should be remembered, too, that clot forming in contact with a comparatively healthy vein wall, as is the case in many instances, takes time, and sometimes a very long time, before adhering to the wall, and until it does there is the risk of its detachment when the patient moves. There can be no doubt that many have died of pulmonary embolism, when, with a little more vigilance on the part of the attendants, the patient might have been saved.

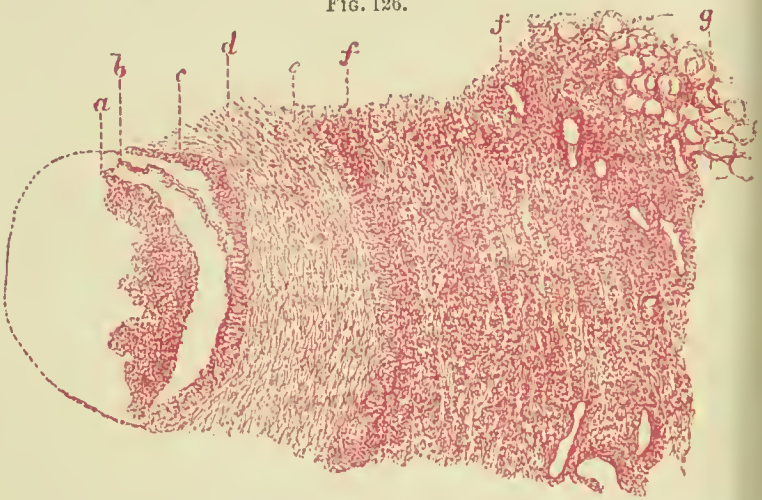
These remarks apply to embolism of the larger branches of the pulmonary arteries, which never give rise to further changes in the lungs, and the patient dies from asphyxia. If the smaller branches, however, become plugged, then arise those secondary infarcta already mentioned, and, in the case of septic embolism, lobular pneumonia of pyæmia and gangrene of the lung.

Dr. Wilks has also shown ('Guy's Hosp. Rep.,' 1870) that, as in phlebitis, morbid matters may be taken up by a vein and carried into the circulation through the right side of the heart, thereby giving rise to *venous pyæmia*, so disintegrated fibrin of the blood may be carried into the arterial system from the left side of the heart, and give rise to *arterial pyæmia*. Febrile symptoms with joint-pains and rigors, associated with aortic and mitral bruit, ought to excite suspicion of this latter affection; but when the liver or spleen is found enlarged, the diagnosis is confirmed. He also points out how this occurs as a secondary fever of the nature of pyæmia, after scarlatina, which is often followed by joint-pains, and not unfrequently by endocarditis. In confirmation of these views I may mention that it has twice fallen to my lot, in the case of female patients, aged respectively fifteen and twenty years, to amputate a leg for gangrene, the result of occluded femoral artery after scarlet fever. In neither of these cases had any vessel to be secured, while in both a good result rapidly ensued. Arterial pyæmia.

Pathology.—The changes which take place when an artery becomes plugged, differ according to the size of the affected vessel. If it be a *terminal* vessel, the immediate result is congestion of the vascular area concerned, with subsequent hæmorrhage and atrophy of the tissue. The various stages may be studied with great precision by the ophthalmoscope in occasional cases of embolism of the arteria centralis retinæ. It is unnecessary to discuss whether the process is due to vasomotor paralysis or alteration of blood pressure, since it is of pathological rather than of surgical interest, and the questions involved are fully stated in all pathological works. We shall, therefore, only remark further that embolism of the small vessels is important or otherwise, according as the source from whence the plug is derived is healthy or not. If the clot be septic, then the resulting infection will probably lead to an abscess, and hence the probable connection of abscesses in the pelvis with those in other parts after labour, or after operations in the viscera or connective tissue of the body. But embolism of the medium size and larger arteries is followed by changes of the very greatest moment in the walls of the affected vessels. Unfortunately they have, up to the present time, not been fully worked out as regards embolism, though we can obtain considerable aid towards understanding what takes place by availing ourselves of the experiments which have been made for us by the ligature of vessels. When an artery of any size becomes closed by an embolism, the canal may of course be gradually restored by the disintegration and washing away of the plug; if not, the presence of the clot acts as an irritant, inflammation is set up, and the clot becomes adherent to the wall of the vessel. It is a disputed point whether the next stage is one of organization and vascularisation of the clot, or of absorption of the clot by vascular granulations which spring up from the wall of the vessel. Weber holds the former, but Cornil and Ranvier the latter view. This difference, however, does not matter, as all that is important

would be granted by either, viz., that embolism leads sooner or later to a local inflammation of the arterial walls. But if arteritis is thus produced by a simple and healthy clot, the intensity of the local disease will vary as the plug is healthy or septic, and, it is surely not too much to suppose, that some plugs will so excite the component elements of the surrounding arterial coat that its tissues will become disorganized, its cellular elements multiply rapidly, and the coats as a consequence give way. Indeed, we know that these changes do actually occur in small vessels, and abscesses follow; so without doubt, also, though the fact is less generally recognised, the same changes occur in the larger arteries and lead occasionally to aneurism. I shall revert to this subject in the chapter on aneurism, and will add no more here, since what has been already said, together with the subjoined wood-cut of the state of the arterial coats after embolism, may sufficiently explain the morbid processes set up in the larger vessels.

Fig. 126.



Transverse section of the upper part of the radial artery plugged by an embolus of septic origin some days before death. From a case of ulcerative endocarditis (boy, æt. 19). Drawn by Dr. J. F. Goodhart, to show the condition of the adventitia.

a. Clot.
b. Internal coat.
c. Internal elastic or fenestrated membrane.
d. Middle muscular coat.
e. Outer elastic membrane.
f. Adventitia crowded with abnormal nuclei, and proportionately thickened.
f'. Region of vasa vasorum.
g. Fat.

Treatment.

Treatment.—The objects which surgeons should have in view in the treatment of a vessel occluded by an embolus are, to favour the venous circulation through the limb by its elevation, and to establish the arterial collateral circulation by maintaining the warmth of the limb by means of cotton wool carefully wrapped round it over oiled lint. Pain can be relieved by sedatives, such as chloral or opium given by the mouth, or morphia injected subcutaneously, while the powers of the patient are to be maintained by nutritious diet, by stimulants carefully administered, and by tonics.

When gangrene has resulted.

When gangrene has taken place, the parts may be covered with some antiseptic material, as carbolic acid in a watery or oily solution, one part to thirty; or with powdered charcoal, chloralum, terebene or

MacDougal's disinfecting powder; but if the odour is not very offensive, simple oakum surrounding the part may be sufficient.

When the line of demarcation has formed and the gangrenous part can be removed by amputation, such an operation may be performed, but the surgeon should always be cautious in interfering with these cases. He should at the same time take every precaution that any necessary or desirable operation is not unduly postponed.

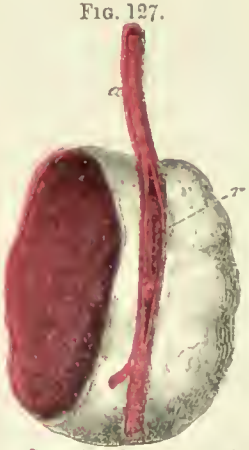
ANEURISM.

Definition. An aneurism is a fusiform dilatation of, or a *sacculated tumour* communicating with, the canal of an artery, and is formed more or less from its walls. When all the coats are involved in the sacculated dilatation it has been the custom to describe it as being *true;* but as Varieties. *false* when the two inner coats have given way and the external or cellular alone remains. I agree with Holmes, that it is impossible clinically to perceive any difference between true and false aneurisms at the time they generally come under observation, inasmuch as the true become false as they grow, and the false are by far the more common. I hold, moreover, with Moxon, that pathologically, "when an aneurism has reached any size, and often before it has well started, the several coats of the vessel have lost by inflammation their distinctive character, and that the sooner the division of aneurisms into varieties by the supposed behaviour of the several coats becomes purely a matter of history the better."

When the distension of a vessel involves its whole calibre, a *fusiform or tubular aneurism* or aneurismal dilatation is said to exist, whether the enlargement be or be not due to an inflammatory disease of the arterial coats. Fusiform.

What is described as a *diffused, spurious, or consecutive* aneurism is where the sac of the aneurism is not formed by any of the arterial coats, but by the muscles and condensed cellular tissue of the part into which the extravasated blood has been effused from a ruptured aneurism or a ruptured artery; although these terms should not be applied to cases in which there is *diffused extravasation* of blood. Diffused.

Fig. 127.



Sacculated traumatic aneurism. Drawing 44[18], Guy's Hosp. Mus. Mr. Poland's case.

A dissecting aneurism is one in which the inner coat is separated from the middle, or, where blood is extravasated into the thickness of the middle coat itself or between the middle and external coats, the blood re-entering the cavity of the artery at some distant spot. The aorta is the part usually affected, and even its whole length may be involved. An excellent example of this affection has been recorded by Dr. Fagge ('Med.-Chir. Trans.,' vol. lii). These cases, however, rarely come under the hands of the surgeon. To show what an aneurism may do, the following figure (Fig. 128) is given. It was taken from a drawing in Guy's Hospital Museum. The aneurism of the innominata has involved the left carotid and root of the subclavian, a second aneurism of the left carotid existing above. Dissecting.

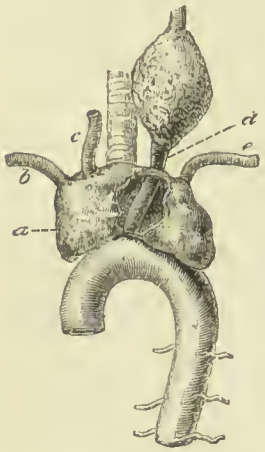
Pathology of Aneurism.

Pathology of aneurism. A low form of inflammation of the arterial walls is without

Over-action of heart.

doubt the most common predisposing cause, while over-action of the heart and circulation is the exciting cause of aneurism. Direct injury to an artery is an occasional cause (traumatic), although more frequently the injury sets up the disease in the artery that produces the aneurism. Whenever the coats of an artery are weakened by accident, disease (suppurative or otherwise), or the loss of their natural support, they become liable to dilate under any sudden or prolonged increase in the force of the circulation under violent exertion, or from a sudden emotion of the mind. Dr. Rendle, of the Queen's Prison, Brixton, has recorded two cases in which abdominal aneurism could be traced to the shock caused by a sentence of transportation. Hence aneurisms are more common in the aorta, where chronic inflammatory changes are so likely to appear, and the heart's action more directly felt; at the bifurcation of an artery, where the force of the circulation is always more powerful; or, at the flexure of joints, where muscular action is the most liable to tell by overstretching or bending.

Fig. 128.



Drawing 4248. Guy's Hosp. Mus.

That aneurism is a disease of the arterial system and not always of traumatic origin is proved from the fact that a man may have an aneurism form when in bed, and that the whole arterial system may be involved in the disease. Broca has mentioned a case of Pelletan's, in which sixty-three aneurisms were found in one body. It is also a disease of middle age, half the cases, according to Lisfranc, occurring between the ages of thirty and forty-five. It is not uncommon, however, to find it in young persons. Syme has recorded an instance in a child of nine. My colleague, Dr. Habershon, had another of femoral aneurism with heart disease in a boy of ten, and *cerebral* aneurism in early life is still more common. But such cases, almost without exception, are associated with extensive vegetations on the valves of the heart, and often with ulceration of the valves. The symptoms are those which Dr. Wilks has described under the term "arterial pyæmia," or mainly, considerable pyrexia and enlargement of the spleen. Many such are now on record, and, beside the parts above mentioned, they have been found situated on the ulnar, popliteal, axillary, mesenteric, and many other smaller vessels. Indeed the frequency of their occurrence can only be estimated by looking into the literature of visceral aneurisms. It will then be found, that though the relation between heart disease and aneurism has not till of late years been studied (and even now only an opinion is doubtfully hazarded as to the connection between the two) very many cases of aneurism associated with endocarditis and emboli in the solid viscera have been recorded at different times. Among the earliest writers on the subject are Joliffe Tufnell in the 'Dublin Journal,' vol. xv, p. 371; Dr. Ogle, 'Path. Trans.,' vol. viii; Dr. Wilks, do., vol. xi; Mr. Holmes, do., vol. xii. Other cases have been recorded in the same 'Transactions' more recently by Drs. Church, Goodhart, Gowers,

Aneurism in children.

Murchison, Semple, and myself. Similar cases may also be found in various medical publications, *vide* 'Bright's Medical Reports,' vol. ii, p. 266; Gull, 'Guy's Hosp. Rep.,' 3rd series, vol. v, p. 299; Ponfick, 'Virch. Archives,' Bd. 58, 1873. See also Wilks and Moxon, 'Path. Anat.,' p. 158-9; Holmes, 'Syst. Surg.,' &c.

Aneurism from embolism.

Various explanations have been given of the occurrence of aneurism under such conditions. It has been maintained by some that the plug leads to sudden obstruction and afterwards to dilatation of the vessel behind it. But a look at preparations of such aneurisms shows, that the dilatation is not behind the embolus, but actually at the plugged spot. Moreover, if the local obstruction leads to dilatation behind it, we ought to find aneurism a more common result of ligature than is the fact; we ought to find it more frequently after embolism than we do, because embolism is a very common affection in one part or another of the body. Other ingenious, though somewhat laboured, explanations have been offered, which need not be mentioned here, and the only one of any importance is that recently ably argued by Dr. Goodhart, attributing the aneurism to a local arteritis, which in its turn has been caused by the embolism. It has been already asserted that when an artery becomes blocked, the clot, unless it softens and breaks down, becomes adherent to the wall, and subsequently the lumen of the vessels is traversed by vascular tissue. If this is true, and that it is, is allowed by nearly all observers, then there must have been some preceding inflammation of the wall of the vessel to allow of this new formation of capillaries. It is no new fact, therefore, that embolism causes a local arteritis, since it follows from what has already been determined. We have only to explain how it is that when embolism causes a local inflammation of arteries in all cases, an aneurism is so rare a result. The explanation is to be found in an examination of the cases in which these are found. They are almost without exception examples of ulcerative endocarditis—a very severe inflammation locally, and attended usually with symptoms of blood poisoning, supposed, and we think rightly so, to be due to the septic nature of the emboli which are detached from the ulcer and carried to all parts of the body. Now, what must happen if such a clot becomes lodged in some part of an artery? In proportion to the severity, or as we should say surgically, in proportion to the foulness of the ulceration, so will be the intensity of inflammation round the embolism; in the more severe cases the rapid formation of an abscess and perhaps a false aneurism; in those somewhat less severe, acute softening and cellular infiltration of the arterial coats, in which case a true aneurism is most likely to occur. In the majority of cases the embolism is not caused by septic clots, and therefore neither aneurism nor abscess are the consequences.

Embolism inducing local arteritis.

Progress and Natural Cure of Aneurism.

Progress of aneurism.

When once formed an aneurism has a natural tendency to increase, the "sacculated" more so than the "fusiform," and the "sacculated" communicating by a small opening with the cavity of an artery, as a rule, runs its course more rapidly than another in which the opening is free. The force of the circulation is more concentrated upon one point of the aneurismal sac when directed through a small than through a large orifice, and more when directed through an orifice than when

diffused over an expanded artery. Hence saccnlated aneurisms attain a much larger size than the fusiform, and are much more liable to rupture. On the other hand, the sacculated aneurism is more capable of a natural cure than the fusiform—the cavity of the former probably undergoing a partial and possibly a complete closure by the coagulation of the blood; whilst it is rare indeed for a fusiform aneurism to undergo any such natural recovery. When the coats are diseased, the fusiform is as likely to increase as the sacculated, and as capable of a spontaneous cure. In any case, therefore, of sacculated aneurism, as well as in some of fusiform, a *spontaneous cure* may take place by the coagulation of the blood in the sac and the subsequent consolidation of the clot. When this process is slow, the fibrin of the blood is deposited in layers or laminæ (Fig. 129); the external layer in contact with the walls of the sac becoming united with them and so strengthening them as to prevent their dilatation; the clot also becomes dense by contraction and decolorised. Subsequent layers form in the same manner as the process of recovery proceed, until the whole sac is filled and finally obliterated. A section of an aneurismal sac thus cured much resembles that of an onion, the outer laminæ of fibrin being thin, fibrous, firm, and bloodless, each successive layer towards the centre approaching more to the colour and consistency of newly coagulated blood. The laminated coagulum lining the sac is frequently called after Broca "active clot," and the soft coagulum in the centre "passive clot," from the idea that this latter is a mere post-mortem and not a vital deposit. This view, however, can scarcely be correct, as there can be little doubt that in all cases of aneurism that are rapidly cured by pressure, digital or otherwise, the consolidation of the aneurism must be due to the simple coagulation of the blood in the sac, and its subsequent induration and contraction, inasmuch as a few hours are evidently too short a period for the coagulum to form in any other way. In the following beautiful drawing (Fig. 130) by Dr. Moxon, taken from a specimen of popliteal aneurism which was cured in a man under my care two years before death by digital compression applied for four and a half hours (*vide* 'Guy's Hosp. Rep.,' 1869), the whole pathology of aneurism is shown.

Fig. 129.



Laminated coagulum removed from axillary aneurism twelve years after Mr. Key had ligatured the subclavian artery. Prep. Guy's Hosp. Mus., 1499[64].

Spontaneous cure.

Appearances of a cured aneurism.

Consolidation due to coagulation of blood in sac.

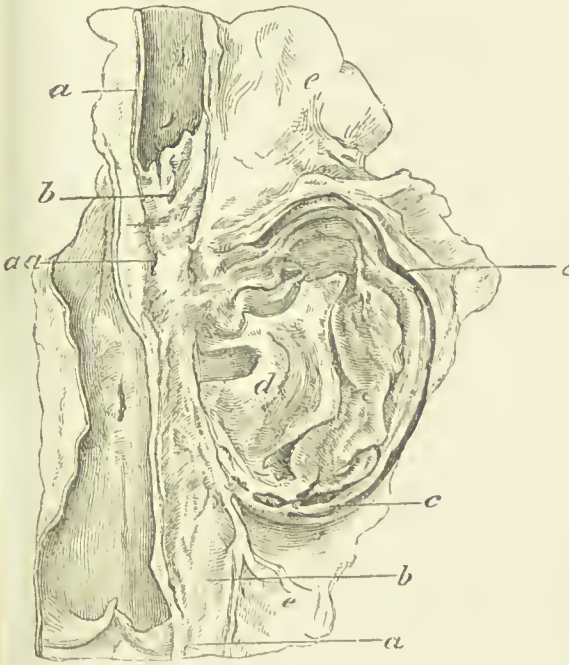
Colles' views.

Colles, of Dublin, and some older pathologists, believed that the fibrin which lines the sac was the product of an exudation from the lining membrane of the same, and that successive exudation of this material formed the laminæ. This view, however, is now almost exploded. Le Fort also accounts for the cure of the fusiform aneurism by inflammation of the inner lining of the sac, and he regards the fusiform as a simple dilatation, which it is not in all cases. Most pathologists, however, now admit, that where the inner tunic of an artery exists in a healthy state in an aneurism, the coagulation of the blood within the sac does *not* take place, and consequently that a spontaneous

cure is impossible, and that in the sacculated or fusiform aneurism successive deposits of fibrinous laminæ only take place when the internal membrane is absent, from the contact of the blood with the walls of the sac.

Fig. 130.

Section through an aneurism of the popliteal artery, cured nearly two years before by digital pressure. The aneurism is not dissected out, but left embedded in the popliteal fat, *e*, *e*.



a. The section edge of the arterial coats were healthy.

a, *a*. The coats in the diseased and occluded part of the artery. Their substance is dispersed and blended with the new fibrous tissue, *b*, *b*, which fills the vessel, yet not so much diffused but that they can still be traced to the mouth of the aneurism (opposite the upper *c*).

c, *c*. The aneurism sac, composed of laminated clot and compressed tissue welded together indefinitely.

d. Scarcely laminated clot, filling the hollow of the sac.

The vein, with two valves in its lower part is seen close behind the artery.

Mr. Poland has recorded a case, probably unique, occurring in the practice of Dr. Adams, of Dublin, of fusiform aneurism of the subclavian, which tends to support this theory. ('Med.-Chir. Trans.,' vol. lii, 1869.)

Cure of aneurism by distal occlusion.

An aneurism may also be cured by the distal occlusion or plugging of the artery beyond the sac with a clot that has been dislodged by the force of the circulation, accident, or design. The vessel at first may be only partially closed by the clot, yet fresh fibrin will soon be deposited upon the "embolic plug," and complete obstruction be produced. This natural mode of cure is utilised in the distal operation for the cure of aneurism, and in the cure by manipulation.

Cure by sloughing of sac.

Recovery may also be caused by the sloughing of the tumour (suggesting the treatment by caustics).

Pressure of sac on artery.

It is likewise on record that the artery with which the aneurism is connected may be obstructed either above or below the sac by the pressure of the aneurism itself, either from its being bound down by a strong fascia, or from the pressure caused by effused blood following its rupture; and, in the treatment by flexion, this natural mode of cure is made use of.

Mode of extension of an aneurism.

As an aneurism increases and encroaches on the neighbouring parts, tissues are separated and even absorbed; bone may even be gradually worn away by the steady pressure of the pulsating tumour, so that in thoracic aneurism the sternum may be perforated or the bodies of the vertebræ eaten away,

and the spinal canal opened (Prep. 1489[30], Guy's Hosp. Mus.). During this increase the tissues also surrounding the sac may inflame, though they rarely suppurate, and, by becoming condensed, give the aneurism some support and tend to retard its growth. In rare cases this inflammatory action may involve the sac itself and cause sloughing; but when the aneurism increases unchecked it will eventually give way. A thoracic or abdominal aneurism may burst into a mucous tract such as the trachea, pharynx, œsophagus, or intestine, and, when it does, Dr. Gairdner ('Med.-Chir. Trans.,' vol. xlii) has shown that it proves fatal by a recurrent hæmorrhage through a *small* orifice. When it bursts into a serous cavity, such as the pleura, pericardium, or peritoneum, it destroys by a sudden hæmorrhage through a *large* aperture. Cases are also on record where it discharged itself into a vein or the pulmonary artery. External or surgical aneurisms burst by the formation and giving way of a slough. Aneurism of the extremities or surgical aneurism may give way into a joint or cellular tissue. It may burst externally only in rare instances.

Termination of aneurism.

On external aneurism.

The surgeon however, has, more to do with external than internal aneurisms, and although the pathology of both forms is alike, the treatment differs. It is to surgical aneurisms, therefore, that the following remarks may specially apply, and first of all as to their symptoms and diagnosis.

Symptoms and Diagnosis.

Symptoms.

Diagnosis.

Pain.

Pulsating tumour.

Expansion of tumour.

Bruit.

An aneurism has no pathognomonic symptoms, and its early symptoms are very uncertain. It often happens that the patient's attention is first directed to some *swelling;* although it may be only that of *local throbbing*—some weakness or stiffness of an extremity—or some *nerve pain* preceding the discovery of the disease; yet such symptoms are not constant. When, however, the surgeon is consulted for pain that shoots down the course of a nerve running in contact with a large artery, he should allow the thought of aneurismal pressure to pass through his mind, and, when this is associated with the presence of a tumour connected with the vessel, the suspicion of its being aneurismal should be excited. If this tumour be *soft* and *pulsating*, and become tense on the application of pressure to the trunk of the artery on the distal side, and flaccid, non-pulsatile, and vanishing on pressure on the cardiac side, and, should pressure on the tumour modify the pulse in the vessel below, the chances of its being aneurismal amount almost to certainty. Should it expand again readily on the removal of the pressure, and this expansion be accompanied with a peculiar thrill on the re-admission of blood into the sac, with a bellows murmur or aneurismal bruit, synchronous with the pulse, audible too on the application of the ear to the tumour, the diagnosis is complete.

State of pulse on affected side.

The pulse of the extremity below the swelling is generally affected, which becomes weaker and slower than its fellow, and, as the disease progresses, it may cease altogether. The blood will then flow in a "venous stream" or cease to flow either from the obstruction of the arterial trunk by the pressure of the aneurism, or the embolic occlusion of the vessel below from a dislodged coagulum. Under these circumstances, fulness of the veins with œdema of the parts supplied by the artery will soon appear, and, at times, excruciating pain from stretching of the nerves will arise. If the aneurism be cervical and the circulation

through the brain be interfered with, giddiness and loss of consciousness may be present, and, where any pressure is made upon the recurrent laryngeal nerve, a peculiar and characteristic hoarseness will be produced. This hoarseness is sometimes associated with loss of voice and laryngeal spasms simulating laryngeal disease. In the case of a woman, æt. 22, under my care, in whom an aneurism existed involving the aorta below the opening of the left subclavian and pressing upon the left bronchus and trachea, this symptom was so severe as to call for tracheotomy. When the cervical sympathetic ganglia are pressed upon, the pupil of the affected side may be permanently contracted, and nerve pains will be present according to the amount of pressure applied. Pressure on nerves, &c.

When an aneurism has partially consolidated, and has either so enlarged, or become so diffused as to press upon the soft parts so as no longer to exhibit any pulsation; when it feels firm, with possibly a soft point here and there, some difficulty may be felt in forming a diagnosis, and the surgeon, under these circumstances, will have to depend as much upon the history of the case as upon the physical symptoms. When external signs of inflammation or suppuration are present, the difficulty will be enhanced, for it must be recorded, that aneurisms under these circumstances have been opened for abscesses. I remember a popliteal aneurism having been so maltreated with a fatal result. Such mistakes of diagnosis, however, ought not to occur, as they are due to carelessness. The diagnosis of an aneurism may generally be made by attending to the history of the case and to the existing symptoms. An abscess in contact with an artery may receive pulsation from it, as may any cyst or even solid tumour, but in all these the pulsation will cease on the application of pressure to the artery above the tumour, without any change whatever taking place in the tumour itself. I have seen a case of lumbar abscess which pulsated freely from aortic contact. It is also rare for such tumours to cause a bruit. Occasionally cases are on record in which an artery in contact with an abscess or suppurating hydatid cyst was opened by ulceration, and gave rise to the idea of an aneurism. Pulsatile tumours of bone may also be mistaken for aneurism; but the fact that they are in bone and more or less ossific, that the bone is expanded, although perhaps irregularly, and that a bruit rarely exists, ought to prevent error. It must be admitted, notwithstanding, that men of the greatest skill and experience have mistaken such cases for aneurism. Difficulties attending diagnosis. Mistaken for abscess. Abscess over artery. Abscess ulcerating into artery. Pulsatile tumour of bone.

Treatment.

There is probably no disease a surgeon has to treat requiring to be dealt with more on scientific principles than aneurism, as all treatment to be effective must be based upon the physiological processes of a natural cure, and he will be successful in proportion as he is able to use these processes and to turn them to account. It has been already explained, that spontaneous cure of an aneurism is commonly caused by the coagulation of the blood in the sac; and, as a consequence, it ought to be an aim to encourage this result in every way, which is to be sought by general as well as by local means. To induce coagulation of blood in the sac by natural processes, it is necessary to have a feeble circulation through it; for this purpose, *rest in the recumbent position is an essential point of practice*, and it ought Treatment of aneurism. Natural process of cure. Induce coagulation in sac. Rest.

to he maintained in every ease; indeed, there is every reason to hclieve, that by it alone, aneurisms have heen cured. Luke ('Lond. Med. Gaz.,' May, 1845), Bellingham, Tufnell, and others, have recorded instances of this nature, Tufnell allowing for diet about ten ounees of solid and eight ounces of fluid food in the twenty-four hours. *As a preliminary to all other treatment absolute rest is, therefore, most essential.*

Venesection and Valsalva's treatmcnt.

With the same object bleeding has been employed, and was at one time largely practised on the authority of Valsalva, who powerfully advocated it, and probably to excess. There seems no reason why it should not he adopted when the force of the circulation is too strong and the powers of the patient are good; as hleeding under these circumstances is not only rational but scientific; it lowers the force of the circulation, while at the same time it has a tendency to render the blood more fibrinous. In internal aneurism it is calculated to be of more service than in external, but practised with cautiou, it is doubtless of value iu hoth. Medicines do not seem to have much influence in encouraging the coagulating process, though the acetate of lead gave some promise of value in the hands of my former colleague, Dr. G. O. Rees, but more exteuded cxperience has not confirmed the hope. Iu external aucurisms, its employment to the sacrifice of local means does not seem justifiable, but iu interual cases it may still be used. When syphilis is suspected as a causc, the iodide of potassium or sodium should be employed. *Nutritious* but *unstimulating* food should be given in all instances to maiutain the powers of the patient, though not to increase the force of the circulatiou. All mental excitement should he positively forbidden.

Acetate of lead.

Diet.

Local treatment.

The principles.

The local treatmcut of aneurism is based on similar principles, the aim hcing to diminish the circulation through the sac. The sueccss, however, which may be expected from the practice adopted will depend much upon the shape of the aneurism, as well as the size and position of the opening into the sac. This may be effected by the following means, viz.—*by compression in one of its forms* of the artery above the aneurism—*indirect;* by *compression of the aneurism itself—direct;* hy the *Hunterian operation, i.e.* the application of a ligature to the artery ou its cardiac sidc; by imitating the rare natural process of closurc of the artery ou its distal side by the application of a ligature, or by pressure, or by the artificial production of an embolic plug by Fergusson's method of *manipulation;* and last of all, it may be laid open and both ends tied (Syme's operation), after the ancient method of Antyllus. The treatment hy electro-puncture, injection, and the introduction of some foreign hody into the sac may he adopted in exceptional cascs.

Compression.

Indirect compression.

Mode of action.

This plan of treatmcnt, to which the term "Duhlin Method" may be fairly given, has now found a lasting place in surgery; as Todd, Hutton, Bellingham, Tufnell, and Carte, though not originating the practice, have adduced ample evidcnce of its scientific and practical valuc. It consists esscntially in the morc or less complete cutting off of the supply of blood from the aneurismal sac by the applicatiou of pressurc to the artery on its cardiac side: and the more completely the currcut of the blood is arrcsted, the more rapid appears to be the cure, modern cxperience fairly proving the soundness of Dr. W. Murray's obscrvation that the principle on which the rapid method rests is clearly "the

complete stagnation of a mass of blood in the aneurism until it coagulates." For this purpose digital pressure is undoubtedly the best; but when it cannot be made available, mechanical means must be employed, and the nearer it approaches to digital pressure, the more is it undoubtedly to be preferred. The practice is theoretically sound and practically safe, and is capable by itself of curing the majority of surgical aneurisms, and even some that are internal. If, however, it does not succeed in curing every case in which it is employed, it doubtless helps, both by promoting coagulation of the blood in the sac, and by producing enlargement of the collateral vessels. When the rapid treatment is employed, the administration of some anæsthetic may be called for, and as its influence is required to be kept up for hours, an additional danger to the treatment has to be taken into account. In other respects the success of the "rapid pressure" treatment has been satisfactory, Mr. Holmes recording in his lecture before the College of Surgeons in 1874, that out of twenty-three cases in which it has been carried out, fifteen were cured. In those, however, in which rapid pressure has been used and failed, the application of the ligature has never succeeded. It is applicable only in cases in which the more usual forms of practice are inapplicable or have failed.

Digital pressure when practicable.

Compression should not be attempted where evidence exists of pressure upon the main vein of the limb, as indicated by œdema; or, where the aneurism is rapidly increasing, or a rupture of the aneurism appears imminent, because in such cases a ligature should be applied to the arterial trunk. It should not be persevered with when sloughing of the skin has been induced; nor ought it, when, from some constitutional irritability, indocility, or stupidity, the patient fails to second the surgeon's aim; for to make the patient understand the objects which the surgeon has in view is doubtless a valuable means of guaranteeing their successful accomplishment. At least, four cases of aneurism of the neck have been cured by digital compression of the common carotid, and M. Rouge, of Lausanne, reports another in which a man, æt. 68, had a carotid aneurism cured in seventeen days by lateral pressure between the thumb, in front of the sterno-mastoid muscle and the fingers behind ('Bull. de la Soc. de Chir.,' 1868, p. 464). Mr. Gay has also apparently cured a carotid aneurism by the same process ('Lancet,' Holmes' Lect. 1873).

When unadvisable.

Digital pressure in order to be successful must be well applied; when indifferently carried out, it is probably less to be relied upon than instrumental pressure. To keep up a steady pressure upon the trunk of any artery for any time consecutively, is a difficult task; and few men could do it more than ten minutes. What is wanted is the steady equal pressure of a finger or thumb applied directly over the vessel which is to be compressed, such pressure being so adjusted as to be sufficient to arrest the flow of blood through the artery, but no more. Greater pressure than this is a waste of power on the part of the surgeon, and a cause of needless distress to the patient. Neither vein nor nerve need be much pressed upon as a rule, nor much pain produced. To carry out this treatment three good men should be employed for four or five hours consecutively, each in rotation carefully applying pressure for ten minutes at a time. By adopting this practice I have cured an aneurism of the thigh in twenty-four hours, and in other cases even less time has sufficed. In a case I recorded in 'Guy's

On mode of application of digital pressure.

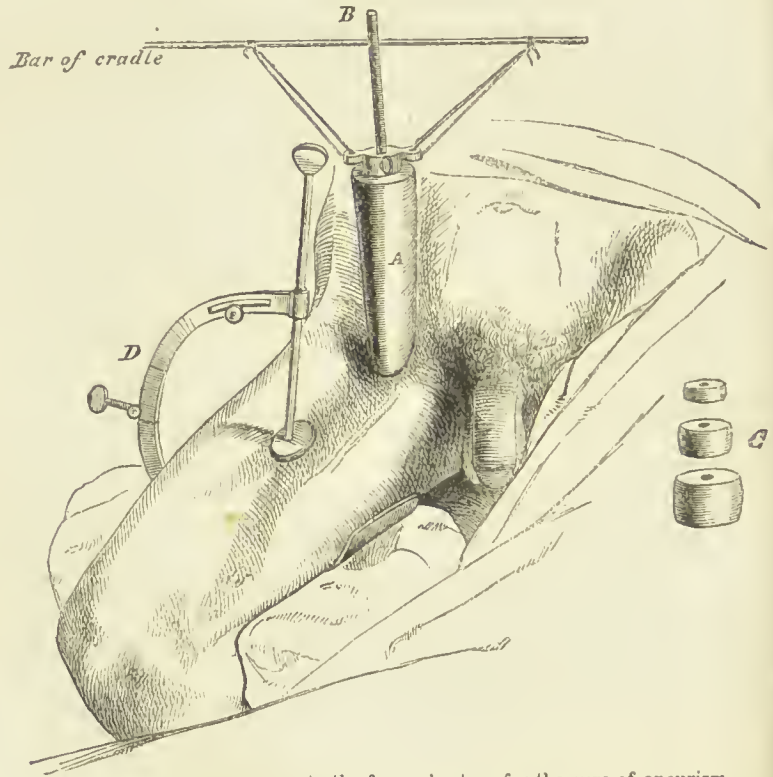
Examples.

Hosp. Rep.' for 1869, a patient æt. 32 cured himself of a popliteal aneurism by pressure in four and a half hours. In one more recent a man æt. 40 cured himself in eighteen hours, after flexion and prolonged surgical treatment by instrumental pressure had utterly failed. M. Vanzetti, in 1855, records another in which digital compression cured a popliteal aneurism in four hours.

When digital pressure can be employed and is successful, it is more rapid than any other, and as a rule less painful. It can also be used where instrumental pressure is inapplicable, as in the case of the carotid. In fact, when admissible, it should always be primarily employed in preference to any other form of treatment. *When digital compression cannot be applied, the next best is instrumental pressure*, and for this purpose

Instrumental pressure.

Fig. 131.



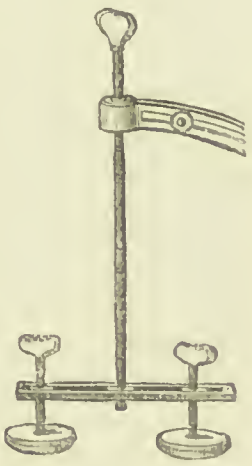
Mode of applying pressure to the femoral artery for the cure of aneurism.

there is nothing equal to a conical weight of lead (Fig. 131 A) covered with leather and perforated with an iron axle (B), upon which extra pieces of lead (C) can be dropped (Belliugham's Method); the weights being so adjusted as to arrest the circulation through the artery and no more. This weight can be slung to a cradle placed over the limb, held by an assistant, or left to the intelligent patient. It can be shifted gently from one spot to another when pressure causes pain, and is far less painful than any other instrument. In popliteal aneurism, the weight may be adjusted to the upper part of the groin, and it is an excellent plan to apply a semicircular tourniquet lower down, by which

Use of weight.

means pressure can be applied alternately. The instruments of Signorini, Bellingham (Fig. 131 D), Skey, Crampton, Carte, or any other that allows the pad to press upon the vessel, and not otherwise interfere with the circulation through the limb, may be used for this purpose. All of these consist of a circle or semicircle of steel, a fixed pad being attached on one side for counter-pressure, and a movable pad, adjusted by a screw, for direct pressure. Indeed, with these instruments carefully adjusted by the aid of a trustworthy assistant who will see that pressure is well applied, maintained, and shifted only when required, most cases of aneurism of an extremity may be treated. In Fig. 132 is depicted an ingenious contrivance made by Weiss, on the principle suggested by Mr. F. Bulley, for the application of pressure to an artery by means of pads which may be used alternately, and adapted to Bellingham's instrument (D, Fig. 131), either by the rigid screw or elastic pressure of Coles' pad; and in Fig. 133 a very valuable one as suggested by Mr. George C. Coles—the pressure being elastic—that may be used as hand pressure or adapted to any of the tourniquets. The treatment by compression requires intelligent supervision, and with this is very successful; but without it is uncertain in its effects.

Fig. 132.



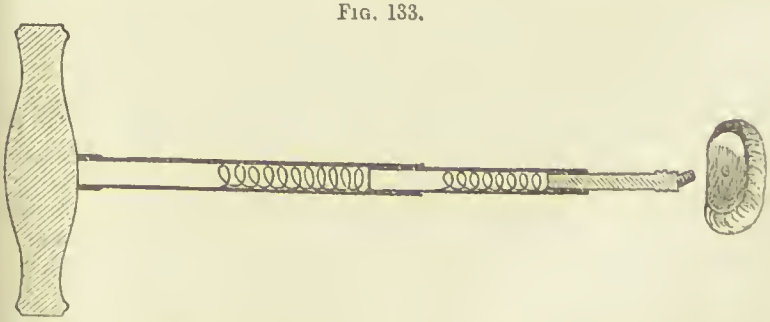
Weiss's double pad.

My friend and colleague, Mr. Davies Colley, who happened to have been my dresser when a case of popliteal aneurism was under treatment by digital compression, informed me, that he proved by experiment, that he could readily arrest the circulation through the femoral artery for six or eight hours at a time with his finger applied directly over the vessel, and the weight adjusted upon his finger—the weight acting in lieu of muscular power that would have been required as the compressing force.

To neutralise the effects of the local irritation of the skin by the pressure, free use may be made of French chalk, starch, or violet

Points to be attended to in using pressure.

Fig. 133.



This instrument consists of a trephine handle, to which is attached a straight rod telescopically arranged. The two upper segments of this rod are hollow tubes, each containing a spiral spring; the lower segment is a solid brass rod fitting into the upper, having at its extremity a screw at an obtuse angle. To the end of this a pad, composed of cotton-wool and horsehair, is adjusted.

powder. To allay pain, opiates, or hypnotics, as chloral in full doses, may be given, and in some cases even chloroform may be used and its influence kept up for several hours, to allow of complete compression being maintained. Dr. Mapother did this for twelve hours. There

On complete and incomplete obstruction of the artery.

seems little doubt that in a general way, complete obstruction to the circulation is more likely to be followed by a rapid cure than is incomplete, and that next to completely stopping the flow of blood till the aneurism has consolidated, the application of the intermittent complete compressing force is to be advocated, or, in other words, complete compression may be maintained for a certain time, and then given up to be returned to as soon as the condition of the patient will permit. The total suppression of the circulation is doubtless the most rapid plan of curing an aneurism; but the partial suppression is likewise successful although slower. On all these points, however, I should like the Dublin surgeons to speak. Dr. Rawdon Macnamara has done so in an able paper ('Brit. Med. Journ.,' Aug. 19, 1871), from which the following extract has been taken. It epitomises the whole:

Macnamara on the partial suppression of the circulation.

"A case of popliteal aneurism presents itself for treatment. We determine to use compression. We first carefully ascertain the condition of the patient's general health. If anæmic or hyperæmic, we take appropriate measures; and, when we are satisfied upon this point, we apply some one or other of the most improved compressors—those in which the compressing power is modified elasticity. With this we compress the artery in the upper portion of its course, having previously arranged, some three or four inches lower down, the auxiliary instrument by means of which we propose to alternate the pressure. The upper instrument is now made to control the artery, so as but just to arrest the pulsation in the sac. This is the most delicate step in all the procedure, and is regulated by the hand of an intelligent assistant, who at once informs us when the pulsation is arrested; and then and there the further application of pressure is arrested. A roster of intelligent students is now organized, and to them is entrusted the management of the case. Two are appointed to take charge of the patient for one hour, when they are relieved by two others, and so on during the day, whereby we secure unwearied attention during the period that pressure is kept up; and, as in Dublin we visit our hospital at nine o'clock a.m. the treatment generally commences about that hour, and is continued up to nine o'clock p.m., when all pressure is removed, and the patient is encouraged to take his night's rest undisturbed. Next morning the treatment is resumed, and so on until the cure is perfected. At the commencement of the case, we take the patient into our confidence; explain to him the nature of his case and the method we are about to adopt for his cure, placing clearly before him the alternative, with all its possible dangers, which we should have to adopt in case compression should fail. The value of this precedure is very frequently demonstrated by the intelligent interest exhibited by our patients in the management of their own cases, so intelligent as in protracted cases to supplement, if not altogether to supersede, the supervision of them by our students. In the selection of our compressing force, we adopt in its widest sense the maxim 'Nullius addictus jurare in verba magistri.' Should one compressor prove irksome, we try another; if all should fail, we have recourse to digital compression, or to compres-

sion by means of weights; but in every instanee, eonvineed of the soundness of this plau of treatment, we leave no stone unturned to seeure its suceess."

The rapid treatment of aneurism by Esmarch's bandage.

Sinee Esmareh's elastie bandage, however, has been introduced, surgeons have employed it in the treatment of aneurism, and, where sueeess has followed its use, the results have been very striking. Thus, we find that Dr. Walter Reid, R.N., who first adopted the practiee, eured by its means, in fifty minutes, a ease of popliteal aneurism ('Laneet,' 1875); Mr. F. A. Heath, of Manehester, a seeond, in an hour ('Laneet,' 1876); Mr. Wagstaffe, a third, in two hours ('Lancet,' 1876); Mr. Thomas Smith, a fourth, iu three hours; and Mr. Wright, a fifth, in twenty-four hours ('Laneet,' 1877). Mr. Bradley has had, however, one unsueeessful example, Mr. T. Smith two, and I now reeord a fourth, in whieh I am disposed to think the practiee not only failed to eure but did harm.

Case.

The case was that of a man, æt. 45, who was admitted into Guy's, uuder my eare, in Mareh, 1877, with a popliteal aneurism, whieh was inereasing so rapidly that aetive treatment was ealled for. The man could bear neither digital nor iustrumental pressure upon the afferent artery. I eonsequently applied the elastie bandage to the limb below the aneurism, using moderate pressure, allowed the aneurism to fill with blood, and then so compressed the thigh above the sae as to entirely eheek all pulsation in it, these three being apparently the essential points to observe. A subeutaneous injeetion of morphia was also given. The pressure was maintained for three hours eonseentively and a seeond dose of morphia injeeted, but when the baudage was removed the aneurism was deeidedly harder, although pulsation still existed in it. Four days later all elot seemed to have disappeared, and as the aneurism was as big as ever, the elastie bandage was again applied, only on this oeeasion, to soothe the mau, an anæsthetie was used. This treatment was eontinued on this oeeasion for three hours, and at the end, little had been gained from it. A fortnight was then allowed to elapse to allow the parts thoroughly to reeover themselves, when a carbolised eatgut ligature was applied to the artery, and within one week this wound had eompletely healed by immediate union, not a drop of pus having been exuded, indeed, the patient had no idea that any operation had been performed upon his thigh.

The foot, however, soon beeame the seat of anæmie gangrene, and a fortnight after the applieation of the ligature, was amputated in the middle of the leg, and a good reeovery followed.

In this case I am disposed to attribute the gangrene to the employment of the elastie bandage, and fear that from its two applications many of the small arterial branehes that would have earried on the eireulation through the foot, after the ligature of the femoral had beeome bloeked, and that, as a eonsequenee, gangrene followed. The case indeed tends mueh to support the view, whieh Holmes fairly demonstrated in his eollege leetures, that where pressure fails to effeet a eure in the treatment of an aneurism, the suceess of ligature of the vessel is not so good.

Care during process of cure.

An aneurism is known to be eured when it has eonsolidated and lost all pulsation, and the anastomosing arterial branehes around are visibly pulsating. Care, however, must be observed for some days later, and no movement of the limb or manipulation of the sae are to be allowed; be-

cause in case of rapid cure, the clot that has filled the sac must of necessity be soft, and a very little may cause its displacement, and thus interfere with that natural contraction of the fibrin of the blood that is to fill the sac permanently, prevent its dilatation, and cure the disease. At Guy's Hospital, out of 17 cases of poplitcal ancurism consecutively treated by pressure, 11 were cured, and Mr. Holmes informed us in his college lectures, that out of 124 cases so treated in different hospitals, 66 were treated with success, and in 58 without success. Of the latter, in 44, the femoral artery was afterwards tied, and in 8 amputation was practised, 5 dying. Death occurred in one case; and in 4 there was no evidence of subsequent treatment. ('Lancet,' December 19, 1874). In the majority of these cases, instrumental pressure was employed, and in some, the treatment was imperfectly carried out.

On direct compression.

Flexion of limb.

The treatment of aneurism by *direct compression* next claims attention, and in modern times is known as that by *flexion;* for there can be little doubt that the *modus operandi* of flexion in the cure of aneurism is mainly due to three conditions, *first*, to *direct* compression of the aneurismal tumour itself; *secondly*, to indirect compression through the medium of the tumour, intercepting either wholly or partially the supply of blood to the sac; and, *thirdly*, to displacement of the clot, as suggested by Holmes, and the consequent obliteration of the mouth of the aneurismal tumour. This mouth may likewise be so situated as to be closed by the bending of the artery—an aneurism in the posterior wall of the popliteal artery being in a far more favorable position for cure than one on the anterior. At the same time we know that forced flexion of a limb is capable of arresting the flow of blood through the healthy artery. In England, Mr. E. Hart demonstrated the success of this method of treatment in the year 1858, although, in 1857, Dr. Mauuoir, of Geneva, recorded the first successful case in 'L'Echo Médicale' (Neufchatel), and, since that time, many surgeons have successfully applied the practice. To carry it out, the limb must be carefully bandaged from below upwards to the aneurism, and in the case of the popliteal artery the knee should be bent, sufficient force being employed to diminish or arrest the pulsation of the tumour but no more, some turns of the roller maintaining the limb in this position. The thigh should then be flexed upon the pelvis and the patient turned on his side with the limb resting on a pillow. By this plan the arrest of the circulation through the aneurism may generally be effected, and a cure expected. When the flexion is forced, the patient is too often unable to endure the suffering caused by the position. The plan, however, is so simple, and, when bearable, is so successful, that it should always be attempted where it can be applied, and, when unsuccessful, it is almost harmless. To large and rapidly growing aneurisms this method is inapplicable, and probably dangerous, as it may induce rupture; but when any inflammation or other complication exists it ought not to be employed; nor ought it be persisted in when it is not obviously doing good.

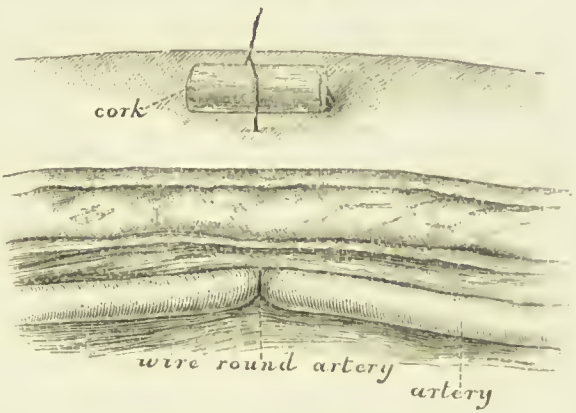
Mode of conducting flexion.

Pressure may likewise be used with flexion where the latter is insufficient, many cases having been reported in which success followed the conjoint means. In one under my care in 1871 I cured an aneurism below

the popliteal space in eighteen hours, by alternating the flexion of the leg with digital pressure in the groin.

M. Liégois, in an interesting paper ('L'Union Méd.,' Aug. 1869), gives eleven cases in which flexion alone proved successful in popliteal aneurism, and also eleven in which it was successful in combination with other measures. In four, it succeeded after other means had failed. On the other hand it failed in twenty-three cases, or nearly half the whole number, and of these, seven are stated to have suffered rupture, and one had inflammation of the sac. Holmes's statistics show nearly the same results.

Fig. 134.



Dix's mode of compressing artery.

Dix's wire compress.

The wire compress of Mr. Dix, of Hull, already alluded to (see p. 421), requires naming as a means of dealing with aneurism. It is a method that has been advocated by Porter, of Dublin, Hilliard, and others (*vide* Mr. Dix's paper in the 'British Medical Journal,' October 30th, 1875, p. 551). It is in reality treatment by compression and not by strangulation. It does not cut the artery nor obliterate it at the seat of operation; therefore in principle and *methodus medendi*, it ranks not with the ligature, but with the tourniquet and other modes of pressure. But forasmuch as the application of the wire requires exposure of the artery by a cutting operation, this process cannot enter into surgical competition with the simpler methods of compression and flexion, yet where these have failed or are inapplicable and operative procedure is inevitable, "then," says the author, "I back my operation for certainty, rapidity, and safety, against any form of ligature—silk, hemp, or catgut—or, against any kind of forceps, 'artery constrictor,' or compressor applied in or through a wound."

The operation is as follows, and it seems to be specially necessary to follow out the exact details with care and attention:

How applied.

The artery is exposed by incision and the aneurism-needle passed in the usual way. A piece of surgical wire, about 9 inches long, is threaded through the eye of the aneurism-needle and carried beneath the artery by the withdrawal of the needle, which is then separated from the wire. A straight surgical needle is then attached to either end of the wire and the two needles (first one and then the other) are passed through the tissues to the surface, so that they emerge on the

skin, one about a quarter of an inch and the other three quarters of an inch from the edge of the wound, on whichever side of it may seem most convenient, *but both on the same side* (Fig. 134). By drawing them through together, the wire forms a loop over the artery and the intervening tissues, and the needles are then detached from the wire. The half of a vial-cork, flat side downwards, is now placed on the skin between the ends of the protruding wire, and firmly pressed down by the fingers of an assistant *in the exact line of the artery*, the wire being at the same time drawn tightly upwards and sharply twisted over the cork, till the current through the artery is effectually stopped and the pulsation of the aneurism ceases. It is of great importance that the position of the cork should be longitudinally over the course of the artery so that the blood-current is checked as much by the downward pressure of the cork as by the upward tension of the wire, the intervening tissues forming a firm compressed pad. The superfluous ends of wire are then cut off, and the wound closed and dressed according to the predilections of the surgeon.

Effects of compress.

When the depression of anæsthesia goes off and the circulation revives, it will be found, that a *feeble* pulsation returns in the aneurism. This, according to the author (who strongly advocates the *gradual* rather than the *rapid* method of producing coagulation in the sac), should be allowed to go on for two or even three days, when the wire is to be tightened in the following manner:—

The cork being firmly pressed down over the artery, the wire is drawn upwards by gentle traction on its twisted ends, and two or three small wooden wedges are pushed in *by an assistant* between the cork and the wire, so that sufficient tension is caused to *entirely* stop all pulsation in the aneurism. If the wire has been sufficiently drawn tightly at first, very small wedges are required, such as two or three bits of a lucifer match, for instance. The wire is on no account to be twisted afresh, lest it break. Meanwhile, by the action of the two or three days' feeble current the sac has been prepared, as it were, for the coagulation of *sudden soft* clot which is now formed, whilst the collateral circulation has also by the same means been encouraged, the result being that in from twenty-four to forty-eight hours, consolidation is perfect; thus about the fifth or sixth day the cure is complete, and the compress may be removed, which is thus done:—Untwist the wire and remove the cork; separate widely the two ends of the wire to lessen the curve as much as possible; clip off one end close to the skin; make gentle pressure with one finger where the cork has been, and by steady traction on the other end of the wire it is readily withdrawn. If it should seem to adhere, leave it till next day, when it must have become loosened in the tissues, and be easily removable.

How to remove compress.

The advantages of this method are thus summarised by Mr. Dix:

I. The wire does not cause ulceration or any damage to the coats of the artery, either external or internal, therefore the blood channel being unopened, *bleeding*, one of the chief dangers of the old operation, *is impossible.*

II. By causing at first a *retarded* circulation and a diminished current, it most accurately imitates the *natural* cure of aneurism, and by allowing time for the establishment of the collateral circulation, the risk of gangrene, the *second great danger* of the ligature, is very much diminished.

If, nevertheless, there were coldness of the limb and a threatening of gangrene, the wire can be at once untwisted and relaxed, or even removed.

III. Ultimately, the current through the artery and the sac is entirely obstructed so as to produce the needful clot. Of course, this complete obstruction can be effected at first if desired; and, therefore, this operation does what no operation, by ligature or forceps, &c., can do, viz. it gives the surgeon a choice between the rapid and the gradual method of treatment. But, as herein described, it is in fact a combination of the two, which is better than either alone.

It will be seen that, in the opinion of the author, the *gradual* method is much to be preferred, and he considers it one of the chief merits of his operation that this effect can be produced.

IV. The wire does not act as a foreign body in the wound, setting up suppuration and impeding the healing process as a ligature does.

V. It is not a fixture upon the artery remaining for an indefinite period, but, its work being done, it can be at once got rid of.

VI. The clot produced by this concurrence of the gradual and rapid method is less likely to break down and suppurate than the soft sudden clot, which is the effect of the ligature.

VII. And lastly. As there is no possibility of bleeding from the artery, the surgeon has a wider choice of locality for operation. For instance, the common femoral or the external carotid, which, on account of hæmorrhagic risks, are usually avoided by the operator, may be safely treated on this plan, which is indeed applicable to all arteries alike.

N.B.—Inasmuch as it does not obliterate the artery at the site of the application of the wire, this procedure, *in its present form*, is not suitable for the distal operation, but it is probable that complete occlusion and obliteration may be effected by the simple modification of applying *two* wires upon the vessel about half an inch apart, between which a clot would form and become organised.

All this is quite trustworthy in traumatic aneurism or in a wounded artery, a wire being applied on either side of the orifice in the artery and the vessel divided between them. This is proved by its perfect success in amputation, &c.

The Treatment by Ligature.

Treatment by ligature.

Such a plan should only be entertained when that by compression in one of its forms is inapplicable, or has proved unsuccessful. It should be carried out when possible by the Hunterian method (Fig. 135), by the application of a ligature at some distance from the sac and not by the "méthode d'Anel," in which the ligature is applied close to the aneurism; because by the Hunterian operation the chief flow of blood through the aneurism is arrested, the collateral circulation maintained, and the artery more likely to be healthy when ligatured at some distance from the seat of disease. The operation is also, as a rule, less difficult.

A moderately thick round ligature should be employed either of silk, hemp, or carbolised catgut. When a silk or hempen ligature is used, it subsequently ulcerates through, or a portion of the artery sloughs away with it. The process takes from nine to twenty days, or more in large vessels, and in this lies the weakness of the treatment by ligature. When the carbolised catgut ligature is employed, some ulceration of the vessel at

the seat of ligature may likewise follow, but a complete division of the artery by ulceration need not take place. On that account the latter

Fig. 135.

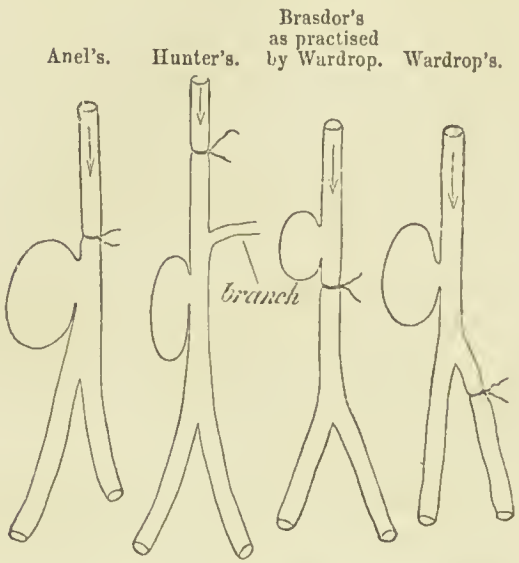


Diagram showing the different operations for aneurism.

ligature is preferable. When the ligature fails, and death ensues, it is from gangrene of the parts below the seat of disease, or, from secondary hæmorrhage. The former is the more frequent cause of death, and according to Dr. Norris, out of fifty fatal cases of ligature of the femoral artery, twenty-three died of gangrene, and only eight of hæmorrhage.

Effects of ligature.

When a ligature is applied to the main artery of a limb, the circulation is, for a time, more or less cut off, consequently coldness of the part may ensue, and even gangrene; congestion, however, generally takes place gradually in the extremity from the blood being forced into the collateral vessels, and with this, some increase of temperature may be felt, with hyperæsthesia, a point already noticed in embolic arterial obstruction. Brown-Séquard explains the elevation of temperature that is often observed in a part after the application of a ligature to its main artery, by the paralysis of the vaso-motor nerves that ramify on or in the coats of the vessel; this paralysis producing a corresponding paralysis of the ramifications of the vessels, and, as a consequence, the blood finds its way freely through the collateral branches into the part below the seat of the ligature; this blood stasis producing both the congestion of the part as well as the concomitant elevation of temperature. ('Archives de Physiologie,' 1851.)

Treatment immediately after ligature.

The surgeon consequently should, after the application of a ligature, do what he can to maintain the temperature of the limb, which is best effected by covering it thickly with cotton wool, at the same time keeping the part raised, to encourage the venous circulation. Simple nutritious food should be allowed, but stimulants only with great caution, and merely enough to help digestion and maintain the force

of the heart's action—the habits of the patient forming the best guide as to quantity. Should pain be present, opium, morphia, or chloral must be prescribed, either by the mouth or subcutaneously.

Subsequent after-treatment.

When the ligature has separated, the wound healed, and the aneurism consolidated, no forcible or prolonged exercise of the limb must be allowed for some weeks, although gentle exercise is beneficial. The limb should also be kept warm, for it has happened that the circulation through it has failed to become full or even sufficient, after the operation, and some permanent weakness and loss of sensation has been left. A patient may, however, live a long life even after a double operation. In 1864 I saw a man, æt. 51, upon whom Mr. B. Cooper had operated twenty-three years before (1841) for popliteal aneurism of the left leg, and of the right in 1843. He had been an orange porter, and subsequently followed his work.

Gangrene of limb after ligature.

When gangrene takes place, it is generally as a direct result of the cutting off of arterial supply from a limb, and of the ensuing blood stasis. As a consequence it occurs within a few days of the operation. It may, however, be produced by the presence of an inflamed or rapidly increasing aneurism, and has then little or nothing to do with the operation. It should be dealt with energetically. If it spread rapidly, and threaten life, amputation of the limb about the line of ligature should be performed without delay. Should, however, it be limited in its nature, and slowly progressive, the expectant treatment must be employed. The warmth of the limb at the same time should be carefully looked to, the sloughing or dying parts covered with well-oiled lint, the venous circulation assisted by the elevated position and by gentle friction, and the powers of the patient stimulated by food and wine; opiates being administered for the alleviation of pain.

Suppuration of sac after ligature.

When the sac of the aneurism inflames and suppurates after the application of a ligature, the case may be regarded as one of local gangrene the result of the operation; it is a dangerous complication, and no definite rules can be laid down for its treatment. Hæmorrhage is occasionally a result of this action, the blood coming from the lower end of the vessel; pyæmia or blood-poisoning is another. In general, when an aneurismal sac suppurates, amputation is the best practice when it can be performed. In August, 1871, I applied a ligature to the left carotid artery of a man æt. 29, for a large aneurism, and death ensued on the thirty-fourth day from suppuration of the sac and sloughing of nearly the whole aneurism. This process had been preceded by some hæmorrhage on the thirteenth day after the operation. The same result may take place after the cure by compression, rapid or slow. It is an open question, however, whether aneurismal sacs that have been suddenly filled with coagula are not more liable to break up and suppurate than others in which the process has been more gradual.

Pulsation in sac after ligature.

In rare instances after the Hunterian operation the pulsation of an aneurism reappears; and a passing, feeble pulsation in the sac a day or two after the application of the ligature is by no means a rare occurrence; nor need it excite any alarm, as it is doubtless due to the passage of a feeble current of blood through the sac by means of a collateral branch. This is more likely to occur when a cure by pressure has been previously attempted and failed, the collateral circulation having been enlarged by the pressure. Should, however, the *pulsation continue persistent*, even after the application of a ligature

Vas-aberrans.

to the main trunk, it will be fair to infer, that a 'vas aberrans' exists, by which the blood is brought direct to the aneurism, and which must be ligatured before a cure can be expected. At times, the existence of this 'vas aberrans' may be made out at the time of operation when the vessel must be looked for before the main trunk is tied; indeed, it may be possible that no necessity will be found to tie the main trunk, as the operation for aneurism is to tie the vessel that supplies the sac, and this may be connected only with the 'vas aberrans' Should it not be possible to apply a ligature to the supplying vessel, other means may be employed, such as compression, or flexion, but, in all probability these had been previously tried and failed, and, under such circumstances a second ligature may have to be put on near the sac; or the original operation for aneurism—

Operations of Antyllus and Syme.

that of Antyllus, practised more recently by Syme—may be required, which is, the laying open of the sac of the aneurism and the application of a ligature above and below its connection with the artery. To do this, however, much boldness and operative skill are necessary to prevent a fatal hæmorrhage. With this object, in a case of axillary aneurism, Mr. Syme made an incision above the clavicle along the border of the sterno-mastoid muscle to enable an assistant to com-

'Med.-Chir. Trans.,' vol. xliii.

press the subclavian artery against the first rib; acting upon the same principle as he adopted thirty years before when he made an incision behind the angle of the jaw to enable an assistant to compress the internal maxillary artery before the removal of the upper jaw. In 1861, he laid open a gluteal aneurism, having previously thrust a bistoury into the tumour over the situation of the gluteal artery and introduced a finger so as to prevent the blood from flowing except by occasional gushes. He eventually thrust his hand into the sac, rapidly turned out the clot, and had the bleeding orifice at once under subjection by the pressure of the hand. Both cases did well. Still this practice is only applicable to desperate cases where all other modes of treatment have failed, or are out of the question. In aneurisms of small arteries, however, it is very applicable. I successfully employed it, some years ago, in a case of aneurism of the radial artery; and again in October, 1871, in a case of traumatic aneurism of the radial, where the vessel was punctured, about the middle of the arm. In the latter, I divided the vessel completely, and twisted both ends, a rapid recovery following.

Brasdor's or distal operation.

When a ligature cannot be applied to the cardiac side of an aneurism, and the treatment by compression has failed or is inapplicable, Brasdor's, or the distal operation may be entertained. This consists in the application of a ligature to the vessel as it leaves the aneurism (Fig. 135). It is not, however, an operation that can be recommended with any confidence, except for carotid aneurism. Wardrop performed it in several cases with success.

Distal operation in aortic aneurism.

The distal operation of the left carotid artery for the cure of aortic aneurism, is, however, well worthy of attention as is proved by the cases of C. Heath, Annandale, Holmes, and Barwell. The credit of the suggestion, however, must be given to Dr. Cockle, who wrote on the subject ('Lancet,' 1869), although three or four cases had previously been recorded in which the operation had been performed for supposed carotid aneurism with success. In aneurism of the innominate artery, it is also open to the surgeon to ligature the

carotid and subclavian arteries consecutively or simultaneously, Mr. Fearn's case and others having made the repetition of the operation justifiable. In August, 1871, I performed Wardrop's operation on a man, æt. 33, for innominate aneurism. The subclavian was ligatured with a carbolised catgut ligature, the wound closed and sealed with lint saturated with the compound tincture of benzoin. A good recovery ensued, and considerable consolidation of the aneurism. The man left the hospital thirty-six days after the operation so well satisfied with the success of the treatment that he did not return to have the carotid ligatured; indeed, he went on so well up to about six weeks before his death that he thought nothing of his trouble. He died from dyspnœa the result of pressure, in August, 1874, three years after the operation. After death the aneurism was found to be full of solid clot, and there was a passage through it to the carotid, with a smooth lining. Unfortunately, the gentleman who took out the preparation threw away the bulk of the clot that filled the sac, which was as big as a fist. The success of the operation, however, was most encouraging.

Case of Wardrop's operation.

The Treatment by Manipulation.

This method also requires notice, since it has been introduced by no less a man than Sir W. Fergusson, and is based on natural although exceptional processes, viz. the embolic occlusion of the distal end of an artery by a dislodged clot. Manipulation may also be employed "to alter the relations of the laminated fibrine in the cavity of the aneurism, so as to bring about a further deposition of fibrine on the projecting surfaces of the displaced laminæ" (Oliver Pemberton's 'Address on Surgery,' Brit. Med. Assoc.). In two cases Sir W. Fergusson endeavoured by manipulating the sac to dislodge the clot, and thus give it a chance of being carried by the circulation into the efferent vessel. In both the success was sufficient to sanction the repetition of the means in appropriate cases when all other treatment is out of the question. In 1872, Mr. Herbert Page, of Carlisle, also successfully treated a case of popliteal aneurism by these means. In the cervical aneurism, the dangers of embolism of the cerebral arteries must be borne in mind; yet at the same time it should be remembered that the Hunterian operation for subclavian aneurism has never been successful, and all other means are nearly out of court. Amputation has, however, been performed under these circumstances with success.

Fergusson's method by manipulation. 'Med.-Chir. Trans.,' vol. xl.

Galvano-puncture, or Electrolysis.

To induce or assist coagulation of the blood in the sac, other means have been suggested, and of these *the treatment by galvano-puncture* as advocated by Abeille in 1849 ('Arch. Gen. de Medecine'), and by Ciniselli in 1856, is one of the most promising in theory, though the practical results have not been equally satisfactory. It consists in the introduction of the two needles of a constant current battery into the sac, with the view of coagulating the blood into a firm clot. The practice is one that can only be entertained in exceptional cases, *i.e.* in those which cannot from their position be submitted to other forms of operation. It is, however, well adapted for the treatment of aneurisms at the root of the neck and the thoracic aorta, and possibly for some forms of abdominal aneurisms.

Galvano-puncture.

The constant current battery should be used, and a moderate current

How applied.

say of five cells, be first employed, its strength being increased gradually, but never to cause pain. The battery may be used for half an hour at a time, about twice a week, yet this will depend upon its effects. The needles should be of steel gilt, sharp, very fine, and about three inches long, and should be insulated to within half an inch of the point. They are to be introduced and removed with a rotatory motion, and may be attached to either pole of the battery. The dangers of the operation are, as stated by Holmes, principally from two causes, "the inflammatory action produced in the sac and the cellular tissue which surrounds it, and the gangrene or ulceration of the skin at the points of entrance of the needles."

Other Methods.

Injection of sac.

THE TREATMENT BY INJECTION is another mode that demands notice, although hitherto it has not been satisfactory. Alcohol, tannin, acetic acid and the perchloride of iron have all been used as coagulating agents, but the last is the drug for which the most can be said. That it has a powerful influence in causing the coagulation of the blood is well known; but to produce this in the sac of an aneurism is a dangerous proceeding. The most dangerous result is embolism, and the next, inflammation and suppuration of the sac. A solution of the perchloride, diluted to one twentieth the strength of the British Pharmacopœia solution, is strong enough, and not more than about twenty drops of the solution ought to be thrown into a large sac. The graduated glass syringe with screw piston should be employed, such as is generally used for subcutaneous injections. Care should be taken that the perforated trocar be well introduced into the cavity of the tumour, and that the afferent as well as efferent artery be well compressed. The escape of arterial blood is the only test of the trocar having entered the sac. The fluid should then be injected, and, by manipulation, mixed with the blood. When the sac seems solid, the canula should be withdrawn, but the pressure upon the cardiac side of the sac should be maintained subsequently for a full hour, to prevent the consolidating mixture of blood and iron being sent onwards into the circulation.

Introduction of foreign bodies into sac.

With objects similar to the above, the late Mr. Moore inserted twenty-six yards of iron wire into an aortic aneurism through a canula, his object being merely to detain the fibrine of the fluid blood; but the result was discouraging in the extreme. ('Med.-Chir. Trans.,' vol. xlvii.) Dr. J. Levis, of Philadelphia, in October, 1873, inserted twenty-four feet of horsehair into a thoracic aneurism in a man aged 41, with some advantage, and on November 25th, 1873, I adopted a like practice, introducing into the sac of a rapidly increasing popliteal aneurism due to embolism, twenty feet of horsehair through a fine canula, with the effect of causing almost complete consolidation of the tumour. The patient was a man, æt. 33, admitted with ulcerative endocarditis, who survived the operation five days. The results thus obtained are quite sufficient, therefore, to justify a repetition of the operation, under circumstances in which all other plans of treatment are unjustifiable or have failed.

Subcutaneous injection of ergotin.

In recent times Langenbeck, with the view of causing contraction of the walls of an aneurism, has been led to inject the parts surrounding the sac with a solution of ergotin. Dr. Dutoit, of Berne, relates in 'Langenbeck's Archiv' (Band xii, No. 3) a case in which he successfully adopted the practice; the man was forty years old, and the

anenrism was supposed to be snbelavian. Fifteen injeetious were made at intervals of two or three days *over* the tnmonr, which gradually diminished. To render the enre eertain, however, digital eompression was snbsequently employed.

Traumatic Aneurism.

On tranmatic aneurism.

An artery receives a punetured or an incised wonnd; bleeding takes place; pressure is applied in order to eontrol it, and the wound heals. In eonrse of tiine a pulsating swelling is discovered and a traumatie aneurism is said to exist.

A nian in wrestling, or after making some snddeu nnprepared-for nuseular exertion, finds something give way in his leg, or fancies he has sprained his knee. Iu a shorter or longer period swelling appears, which steadily increases and is pulsatile, he is the subject of an aneurism. In the *former* case, doubtless the injnry was the direct canse of the anenrism. In the *latter* it produced it indirectly by acting upou a diseased vessel. And yet, if the former aneurism is sacculated either by the expansiou of the reparative material with which the wonud of the artery had been closed, or by the hernial protrnsion of one or more of the coats of the artery through a ruptnre or wonnd of another, or by the condensation of the eellular tissue into which the blood has escaped, it differs in no single praetieal point from the latter or from any other aneurism that has been already considered; and, what is more, it must be treated on the same principles, although as the artery of a tranmatic is healthier than that of a spontaneously formed aneurism, the former may be more readily cured.

Diffused aneurism or ruptured artery.

When, however, an aneurism eansed by any injury is not eucysted; when either from the first it is diffused or becomes so from the rnpture of the sac, or, when any ordinary anenrism rnptures, a different eondition presents itself to the surgeon, and the ease appears more like that of a rnptured artery; indeed, when such a condition eomplicates a sprain, fracture, or disloeation, it mnst be regarded as such, and treated accordingly. The vessel, however, is not to be cut down upon and tied at onee as a matter of eonrse, beeause sueh a praetice wonld be wrong and rash in the extreme—a large proportion of such eases as these reeovering without any such proeeeding. In one where the extravasation is severe and no pulsatiou exists, it is impossible to make out with any clearness the true eondition of affairs.

Ruptured artery with fracture.

A limb either with or without a fracture may be greatly distended, and this from effused blood; but whether the blood has been ponred out from the rupture of a large artery or vein, or some smaller vessel, there eau be no means of knowing, since even the pulsatiou in the vessels below may be indistinguishable on aeeonnt of the effusion. Under these eireumstanees no aetive proeeeding ean be carried out. The limb should be elevated, eold applied, the ease left to nature, and, in a large number of instances a beneficial result will ensue. I can recall several such cases where I antieipated bad resnlts, but witnessed good. If the effnsion is so severe as to be followed by evidence of arrest of eirculation in the limb, the surgeon will be jnstified in eutting down npon the vessel at the point where the history of the case indieates that it is wounded, and in tying both ends after having turned out all elot, &c. In other eases, the main artery may be tied, but too often there will be nothing to be done but ampntation, as gangrene may set in. This operation, however, must be postponed till the

line of demarcation is fairly indicated. No general rule can be laid down for the treatment of all these cases as each one must be treated on its own merits.

Modes of treatment.

But the student should remember—(1) That every aneurism, however caused, if encysted, is to be treated upon the same general principles, and that ruptured traumatic aneurisms are to be regarded as ruptured arteries.

(2) That the rupture of an artery when bound down by a dense fascia, such as the popliteal, is generally followed by complete arrest of all circulation in the limb both arterial and venous, and, as a rule, requires to be treated by amputation, gangrene being otherwise the result.

(3) That in cases of partial rupture there may be less extravasation, and consequently less severe measures may suffice; such as pressure upon the main trunk above, or, if this fail, the application of a ligature to the wounded vessel.

(4) That a ruptured artery in parts less fascia-bound than the leg (as, for instance, the arm) may be treated more as in the case of injuries to arteries by the application of a ligature to the wounded vessel.

On the collateral circulation after ligature.

When an artery is obstructed, the circulation is carried on by what is

Fig. 136.
Anterior view.

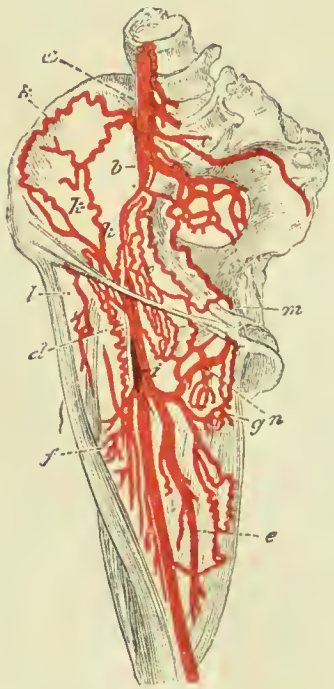


Fig. 137.
Posterior view.



Fig. 136.—*a*. Common iliac artery. *b*. External iliac. *c*. Internal iliac. *d*. Femoral. *e*. Profunda. *f*. External circumflex. *g*. Internal circumflex. *h*. Iliac artery, which had been tied and had shrivelled into a cord. *i*. Remains of aneurismal sac. *k*. Anastomosing branches of the circumflexa ilii. *l*. Anastomosing branches of the circumflexa externa. *m*. Obturator artery, anastomosing with, *n*, circumflexa interna.

Fig. 137.—*a*. Gluteal artery. *b*. Ischiatic artery. *c*. Anastomosing branches of gluteal with the circumflex. *d*. Anastomosing branches of ischiatic with the perforating branches of the profunda.

called the collateral circulation, the vessels coming off above the obstructed part communicating with those which arise below it. At first the vessels are very numerous, but as time goes on their number diminishes, only those most conveniently situated for carrying on the circulation becoming rapidly or gradually permanently enlarged.

To illustrate this beautiful compensatory natural act I submit two drawings (Figs. 136, 137), taken from a preparation in Guy's Museum, No. 1519[12], made by Mr. Cock in the year 1826, from a patient æt. 58, in which case Sir A. Cooper had applied a ligature to the external iliac artery, eighteen years and a half previously for femoral aneurism.

A full description and preparation of the case is to be found in the first volume (first series) of the 'Guy's Reports,' by Mr. Cock. The drawings need no lengthy description, as they explain themselves.

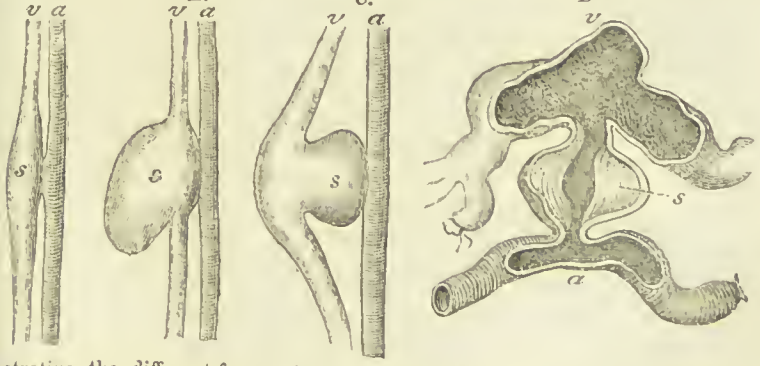
Arterio-venous Aneurisms.

On arterio-venous aneurisms.

When an artery and a vein communicate with each other, the arterial blood passing *directly* into the vein without the intervention of a sac, *an aneurismal varix* is said to exist (A, Fig. 138); and when a sac exists into which the arterial blood flows in its passage to the vein, this condition is called *a varicose aneurism* (B, C, and D, Fig. 138). Both these varieties of arterio-venous aneurisms are now rare; but when venesection was a common operation they were far more frequent; as they are usually produced by the perforation or division of an artery through a vein, the opening between the vessels remaining permanent. Goupil (Paris, 1855) recorded the fact, that out of fifty-seven cases of this affection, thirty-one were the result of bleeding. Yet both forms may originate spontaneously from disease. Cases are also on record where the aorta and superior or inferior vena cava communicated. Wade ('Dublin Med. Press,' 1861) has also recorded a case in which an opening existed between the aorta and pulmonary artery; and my friend Mr. Morris informs me, that he has seen a case in the femoral region, the result of a pistol shot received by a sportsman in America. Indeed, all the large arteries and veins may be similarly affected.

Varieties.

Fig. 138.



Illustrating the different forms of arterio-venous aneurism. A. The artery and vein directly communicating. B and C. The dilation being more in the vein. D. Varicose aneurism laid open.

Aneurismal varix.

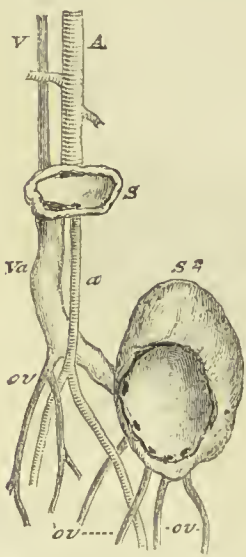
In an *aneurismal varix* the vein assumes in some degree the properties of an artery and becomes enlarged from the arterial impulse. Besides being irregularly dilated and tortuous, the dilatation assumes a fusiform or saeculated appearance, while it also becomes thickened and pulsates.

Varicose aneurism.

In the *varicose aneurism* the sac may or may not freely communicate with the artery or vein. In some cases it will involve the whole calibre of both vessels; or the vein may be hypertrophied and enlarged, as in the aneurismal varix. In a unique case (Fig. 139) recorded by Mr. Cock ('Med.-Chir. Trans.,' 1851), of a traumatic varicose aneurism of the popliteal artery, the sac was small but involved the whole calibre of the artery and vein, and the whole of the arterial blood passed through it. The secondary effects of the disease were also shown with singular clearness. It occurred in a man æt. 28, who eleven years previously had received a punctured wound in the popliteal artery for which two weeks subsequently, on account of secondary hæmorrhage, the femoral was ligatured. He convalesced and returned to his work, but two years afterwards became the subject of "varicose veins." He remained well until three or four months before his admission into Guy's, when he had fever, and, on convalescing and trying to walk, discovered his leg was stiff, painful and swollen. He was admitted with what was supposed to be a large collection of pus beneath the superficial muscles of the calf. The femoral artery below Poupart's ligament and the anterior and posterior tibial arteries were pulsating freely. The cavity was opened, some ounces of dark grumous, pitchy, non-coagulable blood escaped. The next day a quantity of offensive pus flowed away mixed with coagula. For a fortnight everything went well, when arterial hæmorrhage took place, and he lost nearly three pints of blood. After due consultation, amputation was performed, from which an excellent recovery ensued.

On dissecting the limb, Mr. Poland found connected with the popliteal artery an aneurismal sac (Fig. 139, *s*) the size of a pigeon's egg; which was of cartilaginous hardness, and lined with fibrine. The artery (*A*) freely entered the sac from above. The vein (*V*) was obstructed above with coagulated blood, and below was lost in the walls of the sac as a fibrous cord. From the lower part of the sac two vessels issued, the smaller one (*a*) was the continuation of the popliteal artery *greatly diminished in size*, which divided as usual to the leg. The larger (*v a*) was the popliteal vein greatly hypertrophied, pouched, and puckered. It was quite pervious, and passed down for about two inches, when it divided into two trunks; one, which accompanied the anterior tibial artery, was quite *obliterated*, the other led directly into a *second aneurismal sac* (s^2) the size of a duck's egg, with the walls of which its coats became identified. It was this that had been opened. From the lower part of this *venous sac* emerged three or four large impervious branches that were clearly veins accompanying the posterior tibial and peroneal arteries. The contents of these veins could be washed out and the valves seen.

Fig. 139.



Mr. Cock's case of arterio-venous aneurism.

It should be added that the cutaneous veins above described as varicose were greatly hy-

pertrophied, and it was evident that the whole of the blood from the leg was returned through them.

It would appear also that in this case, as a *direct* result of an injury, a *varicose aneurism* formed, into which the whole of the arterial blood flowed. Moreover—

That the arterial blood subsequently found a more direct course through the popliteal vein than through the artery, and as a result the vein became hypertrophied and the artery atrophied. Also—

That the force of the arterial blood current upon the thin coats of the vein caused the gradual dilatation of the vein and the subsequent formation of an aneurism in its course; and that by the giving way of this bleeding had taken place.

The wasting of the femoral vein *above* the upper sac, with the hypertrophy of the same vein *below* the sac, from its taking on the functions of an artery, is a point of interest; and not the least interesting point was the great hypertrophy of the cutaneous veins through which the whole of the venous circulation of the leg must have been carried on.

I have given this case at some length, because it illustrates better than any general description the whole effects, primary as well as secondary, of a varicose aneurism.

With reference to diagnosis it may be stated, that at the point of junction of the arterial and venous streams, a peculiar burring bruit is often felt and heard—this bruit frequently extending down the course of the dilated veins; and, where a sac, in which the two blood currents meet, separates the artery and the vein, there is likewise a soft bruit. The sac is rarely very large, and is made up of condensed cellular tissue and plastic matter.

Treatment of arterio-venous aneurism.

TREATMENT.—In neither of these cases is surgical interference generally required. Should the disease be extensive, and either from pain, mechanical causes, or chances of rupture of the vessels, require treatment, a cure may be attempted by compression of the artery above and the vein below. When the disease is in the bend of the elbow, by forcible flexion of the forearm on the arm and supination of the hand, the brachial artery being in this manner fairly obstructed; a pad may likewise be placed upon the point of communication between the two canals, to make the pressure more perfect. Indirect compression in any other of its forms can also be tried; and, on these failing the case must be treated as one of wounded artery—the vessel must be cut down upon, and a ligature placed on either side of the opening. The veins need not be interfered with, as they will gradually wither so soon as their arterial communication has been cut off.

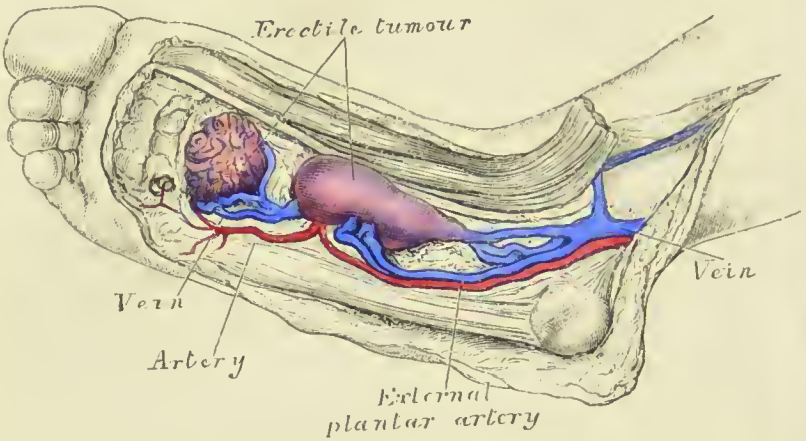
Cirsoid aneurism, erectile tumours, and aneurism by anastomosis.

These have nothing in common with the spontaneous and traumatic aneurisms that have been already described, besides being diseases of the arterial system. They are vascular tumours made up of arterial tissue and formed by a dilatation and elongation of arteries; the term *cirsoid aneurism* being employed when the trunks of the larger vessels are involved, and *aneurism by anastomosis* when the smaller vessels or capillaries are affected. In the cirsoid aneurism, one vessel or many vessels may be diseased—the disease showing itself by the artery becoming tortuous, dilated into pouches, and convoluted. When one vessel alone is affected Gosselin called it *arterial varix*. When the disease is on the scalp (its most common seat), three or four large tortuous arteries

On cirsoid aneurism.

may be seen converging to a centre, where a congeries of dilated arteries will be found, probably of new growth. It may, however, affect the arteries of the extremity. I have seen it in the foot, Fig. 140, and Cruveilhier has reported a case in which the external iliac artery

Fig. 140.



This drawing was taken from a patient of Mr. Poland's, a girl æt. 19. The disease followed an injury, and was treated by amputation, other measures having failed ('Guy's Hosp. Rep.,' 1869.)

was so affected. Cirsoid aneurism is generally found in young people, during the period of growth, and in the majority of cases can be traced to local injury. It can be readily made out by its pulsating nature, and the peculiar tortuous and convoluted appearance of the diseased vessels, not only of the vessels forming the tumour, but of the arteries by which it is supplied.

Treatment of cirsoid aneurism.

Treatment.—All forms of treatment have been tried in these cases, such as direct pressure, injection, the application of ligatures to the vessels that converge towards the growth, and to the main artery that goes to the part: the tumour has, moreover, been laid open and treated by pressure, with the view of causing its obliteration by inflammatory exudation; Gräf, Bell, Arnott, and Lawrence have each recorded successful instances of this form of practice, but no good success in the majority of cases has been achieved.

The best success has, however, followed the removal of the growth either by the application of the ligature or by excision. In 1876 I excised a cirsoid aneurism, situated below the jaw in connection with the facial artery, from a lady, æt. 25, with success. In 1867 I treated a boy aged 14 for a large cirsoid aneurism of four years' growth situated on the right temple. It was supplied with blood by tortuous vessels converging from all quarters, and pulsated freely; I applied acupressure pins to all these vessels, even to their division, without success; the growth for the time became flaccid, but quickly reappeared and increased. Under these circumstances I excised the tumour, making my incisions at some distance from its margin, and ligatured about twenty large vessels as I proceeded; a rapid recovery followed, and the boy was well three years later. In this case it was remarkable to see how rapidly the tortuous convoluted arteries that supplied the tumour withered and

Example.

became of their normal size so soon as the central disease was removed. This process illustrates John Hunter's opinion that "vessels have a power of increase within themselves, both in diameter and in length, which is according to the necessity, whether natural or diseased;" and indicates that the attracting power had its centre in the growth, and not in the afferent arteries. In a third case, that of a girl æt. 12, I removed the growth by a subcutaneous ligature with like success; and, more recently, in a man who had such a vascular pulsatile growth in his left cheek, which appeared to have had all the afferent arteries tied without success before he came into my hands. I ligatured the whole mass subcutaneously, and a recovery followed. Four years later, however, the disease returned, and in June, 1877, I excised it—the wound healing rapidly. Indeed, the only successful cases of treatment of cirsoid aneurism that I have dealt with or seen, have been those in which the growth itself was treated by removal.

Cases of aneurism by anastomosis are very amenable to treatment by styptic injection, the galvano-cautery, or the ligature.

Nævus.

Telangeiectasis, Erectile Tumour, or Angeioma, is essentially a disease of the capillaries, appearing in a general way to be made up of a mass of vascular tissue, the tubes freely intercommunicating with each other. It is true the walls of the vessels are indistinguishable in an advanced case of the disease, the nævus appearing as a collection of cells or spaces, opening widely into one another, through which blood flows. When the arterial supply is very free, the growth appears florid, warm, and pulsatile, and is then called an *arterial nævus;* when the venous element predominates, the growth is less florid, has a congested bluish appearance and does not pulsate, and is termed a *venous nævus.* On nævus. Arterial. Venous.

These growths for the most part appear in the skin or subcutaneous tissue, are frequent on the head and often multiple. Rare examples are on record where they affected deeper parts, even the viscera and the brain (*vide* Wilks and Moxon, 'Path. Anat.,' and Morris, 'Path. Trans.,' vol. xxii). In a clinical point of view they may be divided into the *cutaneous* or pure skin nævus, the *subcutaneous* or cellular tissue nævus, and, the *mixed form* where both tissues are involved; which distinction has an important practical bearing. Nævi are, as a rule, diffused, that is, they have no distinct capsule, but in many cases they are encysted, and may be treated accordingly. Venous subcutaneous nævi appear to be more frequently encapsuled than the cutaneous and arterial. Cutaneous. Subcutaneous.

Nævi, moreover, are generally congenital, or make their appearance soon after birth. They occur, however, at a later period of life and then seem to be due to some injury or wound. These nævi at times grow quickly, the cutaneous form rapidly spreading; the more florid and arterial the growth the greater is its tendency to spread; the venous nævus is less progressive. They may grow also for a time and then stop; indeed, they all have a tendency to become stationary after a period, and even to degenerate. It is not uncommon to meet with nævi that have begun to undergo this process before the birth of the child; and I could adduce many cases in which the nævus was ulcerated or even sloughing at birth. In feeble or cachectic children it is not uncommon for these "marks" to ulcerate or slough, and, after measles, fever, or other depressing illness, the destruction of the growth is sometimes very rapid. These facts show that nævi, although blood tumours, are not long-lived growths Congenital. Their progress. May ulcerate.

and have a tendency towards early death. When they do not ulcerate or slough, they undergo degenerative changes, and the most characteristic is the cystic form (Fig. 141). When the skin undergoes this change, the surface becomes warty and vesicular, the vesicles containing more or less blood-stained serum. When the cellular tissue is the part involved, cysts will still appear of a like nature, but occasionally the whole growth passes into a mass of cysts of different sizes bound together by fibrous tissue. This degenerative change is very typical. To account for the formation of these cysts is no easy matter, no satisfactory explanation indeed of their production has yet been given.

May degenerate.

Fig. 141.



Drawing of degenerating nævus. Guy's Mus., 160[54].—Hilton's case.

Pigmentary nævi.

Some nævi are pigmentary and are then termed moles. They are far less vascular than the forms already alluded to and have no tendency to spread. They grow, it is true, with the growth of the subject, but as a rule in no greater proportion; in exceptional instances their increase is rapid. They do not appear to have a tendency to ulcerate, slough, or undergo the cystic degeneration like the vascular nævi, but have a special tendency to become the seat of cancerous disease, and particularly of the melanotic form of cancer. That is, subjects who become the victims of cancer and have moles, are often attacked primarily in such structures, and, as the cancer originates in a pigmentary growth, it takes on its character and becomes melanotic. I have seen many such cases, and so many others have been now recorded as to place the question beyond doubt.

Their tendency to become the seat of cancers.

Treatment.

Treatment.—Unless a nævus is so situated as to be an eyesore or an inconvenience, or unless it show a decided tendency to rapid increase, there is no necessity for operative interference. For a certainty, after a time, it will cease to grow, and also as certainly degenerate or waste, so that under such circumstances it is not necessary to interfere. Should, however, the nævus be so situated as to be an inconvenience or a deformity; or should it grow so rapidly as to threaten to become either, something must be attempted, and this something is to be determined by the nature of the nævus and of the tissue in which it is placed. If *purely cutaneous* and not involving deeper tissues, it may be destroyed by some external application, such as caustics, nitric acid, or potassa fusa, chloride of zinc, or tartarized antimony, the two former being applied directly to the part, the two latter in the form of Vienna paste, or otherwise. The hot iron and the gas or galvanic cautery are also very valuable destructive agents; one touch of either of these latter, steadily applied, destroying the growth, and with but little pain.

When interference called for.

Caustics.

Cautery.

In the *purely subcutaneous nævus* the treatment by caustics or cautery applied as a caustic is clearly inapplicable. When encysted, as very often it is, *excision* is the best remedy, but care should be taken to save the skin When such treatment cannot be adopted the nævus may be strangled by a ligature applied subcutaneously,

Excision.

as illustrated in the drawing Fig. 142, or, it may be injected with the perchloride of iron of the pharmacopœia strength, with a solution of tannin in water in the proportion of ʒj to ʒj, or of the chloride of zinc grs. xij to ʒj of water, about twenty drops being thrown into the centre of the growth, care being taken beforehand to tear up the texture of the tumour with a needle. The object of this treatment is to coagulate the blood in the tissue, and thus promote its consolidation and cure. In many cases injection causes inflammation, suppuration, or even sloughing of the growth, and though in this manner a cure may be obtained, it is often by deformity.

Subcutaneous ligature.

Injection.

Fig. 142.



Mixed nævus with the ligatures inserted round its base subcutaneously before being tied.

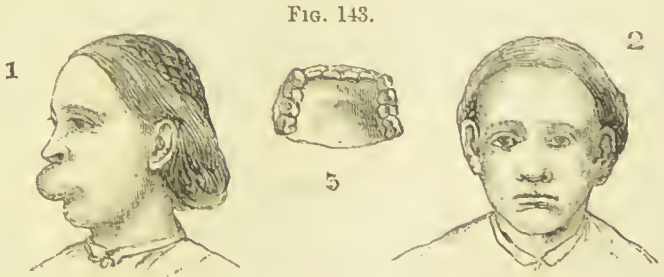
The treatment by injection when the nævus is on the head or trunk is, however, attended with great danger, more particularly from embolism. I lost a patient where the nævus was on the cheek from this cause in a few minutes after the operation. For the above reason it is well to apply a ligature to the base of the growth and then inject; or to isolate the growth by means of the pressure of a metallic ring *before* injecting.

Dangers attending injection.

In the *mixed variety*, when the skin appears to have been involved secondarily by the extension of the disease from the cellular tissue, the nævus may be treated by excision, subcutaneous ligature, or injection.

When the skin, with the cellular tissue, is extensively involved and the nævus defined, the whole may be removed by excision; but when otherwise, by ligature. When the nævus is pendulous, or when it can be isolated from the parts beneath, excision is most suitable, and, when hæmorrhage is dreaded, the base of the growth may be previously held in a flat clamp. In several instances I have excised the nævus by cutting on pins that have been inserted beneath its base; keeping the pins as points round which a ligature might be applied, and, by which the edges of the wound might be brought together. When the thickness of the lip is involved in the disease and the disease is limited, a V piece may be taken out with the growth advantageously, but when the whole lip is involved the growth may be dissected out, leaving the skin. The drawing below is of a case in which this operation was successfully practised (Fig. 143).

Fig. 143.



1. Nævus involving the whole of the upper lip. 2. After removal.
3. Flattening of the teeth from the pressure of the nævus (from 'Guy's Reports').

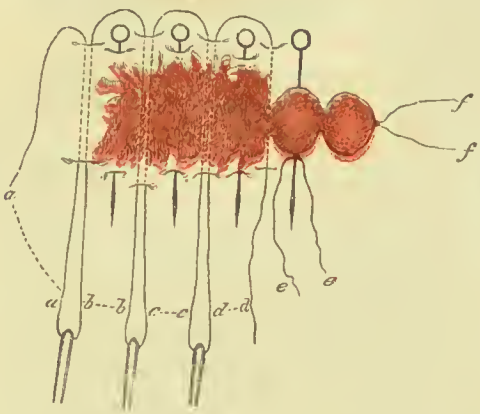
Within the last few years I have successfully treated many of the mixed varieties of nævi with the galvanic cautery, by simply perforating them with the heated needle in many points (ignipuncture).

Setons in diffused nævi.

The treatment of a diffused nævus by means of setons is a practice that can also be strongly recommended. Several setons steeped in the solution of the perchloride of iron are often sufficient to coagulate the blood or to set up enough inflammatory action to cure the growth. When a nævus is extensive and is to be treated by the ligature, it may be dealt with piecemeal (Fig. 144). It occasionally happens that the liga-

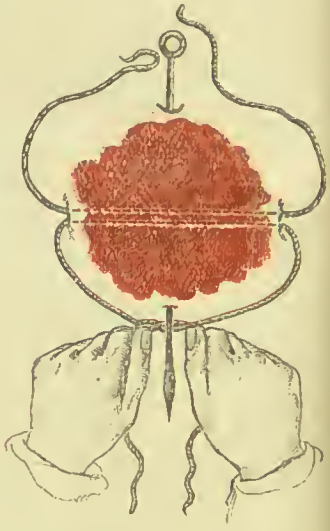
Piecemeal ligaturing.

Fig. 144.



Illustrating the method of ligaturing a large mixed nævus in sections around pins. At one end the pin has been removed, and the knot completed (*f*).

Fig. 144a.



turing of half a nævus cures the whole by the extension of the inflammatory action. In nævi involving the eyelids this suggestion is of value, and, in my own practice, several instances of cure have followed the application of a ligature to half the growth.

In a mixed nævus of moderate size when the cure by ligature is to be carried out, a pin may be passed beneath the growth, and also a needle at right angles to the pin, armed with a double ligature (Fig. 144a). The nævus is then strangled in halves by the ligatures tightly drawn beneath the pin ; but before the ligatures are finally tightened it is well to puncture it to let out the serum and blood, to relieve tension, and to allow of the more perfect strangulation of the growth. When this act is completed the pin may generally be removed.

Small nævi may be vaccinated, although the chances of a cure by such means are very small. The same also must be said for compression.

Fig. 145.



The best needle for the application of a subcutaneous ligature to a nævus is shown above.

Richet, "Aneurism," in 'Dict. de Méd. et de Chir. Prat.,' vol. ii.—*Léon de Fort*, 'Diction. Encyclopédique des Sciences Médicales,' 1866.—*Broca*, 'Traité des Aneurysmes,' 1856.—*Lisfranc*, 'Des différens Méthodes, &c., pour l'Oblitération des Artères,' 1834.—*Scarpa*, 'On Aneurism,' Wishart's Translation.—*Bellingham*, 'On Aneurism,' 1847.—*Tufnell*, 'On Treatment of Aneurism by Compression,' 1851.—*Holmes*, 'System of Surgery,' 2nd ed., 1870.—*Hodgson*, 'On Arteries and Veins,' 1815.—*Dr. Norris*, 'American Journal.'—*Dr. Stephen Smith*, Ditto.—*Erichsen's* Cooper's 'Surgical Dic.,' 1861.—*Wardrop*, 'Cyclop. of Surgery.'—*Syme*, 'Observ. in Clinical Surgery,' 1861.—*Fergusson, Sir W.*, 'Med.-Chir. Trans,' vol. xl.—*Dr. Jones*, 'On Hæmorrhage.'—*Bryant* 'Lancet,' April 4th, 1874.

THE LIGATURE OF ARTERIES.—SPECIAL ANEURISMS, &c.

Importance of anatomical knowledge.

John Bell wrote seventy years ago "that the right way of securing a great artery is perhaps one of the most important points in practical surgery;" and to do this with nicety and precision requires a sounder and more accurate knowledge of anatomy than any other operation.

"Before undertaking to tie an artery, the surgeon ought to know its general course and its relations, and especially the prominent part or parts which are to guide him to the position of the vessel; he ought to have familiarised himself by frequent dissection with the thickness of the parts covering it, and their appearance as far as that can be judged of in the dead body; and finally, he ought to know the usual position of its principal branches, and the anastomosis by which the circulation may be expected to be restored. It is advisable also to be aware of the leading peculiarities in course, relations, bifurcation, &c., which the operator may perhaps meet with, and for which he ought to be prepared." ('Holmes's System,' vol. iii, p. 545.) In fact, without anatomical knowledge, any attempt to tie the trunk of a large artery must be surrounded with difficulties and fraught with danger, whilst with it, the operation becomes in the hands of an experienced surgeon an act of precision and apparent simplicity.

In a former chapter, the mode of applying a ligature to a divided artery after operation, was discussed and illustrated; and in the present, attention will be directed to the application of a ligature to an *artery in continuity* as in the operation for aneurism, or the arrest of hæmorrhage from a punctured wound. To accomplish this, the surgeon has to go through several stages of thought as well as of action.

General rules to be observed in operating.

He has *first* of all to make out with precision the *exact course of the vessel to be ligatured*—which may be done by the artificial linear guides with which he ought to be familiar, the muscular guides to its position, and the recollection of the anatomical relations of the vessel.

He has, *secondly*, to decide on *the point at which the ligature should be applied*. When for a *wound* in the vessel, this point is already settled, it having been laid down as a rule that, whenever possible, a wounded artery is to be exposed at the seat of injury, and two ligatures applied, one above and below the seat of lesion.

Point of selection.

When for *aneurism*, the question is more open, the 'point for ligature' having to be determined by the surgeon. In deciding this important question, it should be remembered, that if the ligature be applied *too near* the aneurism, there is a risk of the ligatured vessel partaking of the disease for which the operation is required; and if

too far off, the circulation through the aneurismal sac may be too free on account of the collateral circulation of the part.

But above all, the surgeon should avoid selecting a spot *where an artery bifurcates or gives off large branches;* as under these circumstances, the clot that is required to plug the vessel behind the ligature must be absent, and one of Nature's most important hæmostatic agents become lost.

With the decision of these primary and important points the operation itself has to be considered, which resolves itself into *the exposure of the artery, its isolation, the application of the ligature around it, and the after-treatment;* the position of the patient for the operation being previously determined.

Position of patient.

The position of the patient should be such as to render prominent the anatomical guides to the course of the artery, to make the skin tense and to facilitate its division. *It should, moreover, be one of extension,* yet after the artery has been exposed, it is well to remember that the muscles of the part must be *relaxed,* as the artery is thus better brought into view and the subsequent steps of the operation are rendered more easy.

The exposure of the artery is to be made by incision, its course having been clearly made out, and the point determined on beforehand for the application of the ligature. The incision should be in the course of the vessel, its centre corresponding to the point where the ligature is to be applied, an occasional obliquity being sometimes practised when the exact position of an intermuscular interspace in which the vessel lies, is uncertain, and when the artery lies deep. It should, moreover, be free. It need not be so long in a thin as in a fat subject, nor in the case of a superficial artery as in that of a deep vessel; but, under all circumstances, the skin wound should be enough to allow room for manipulation.

First incision.

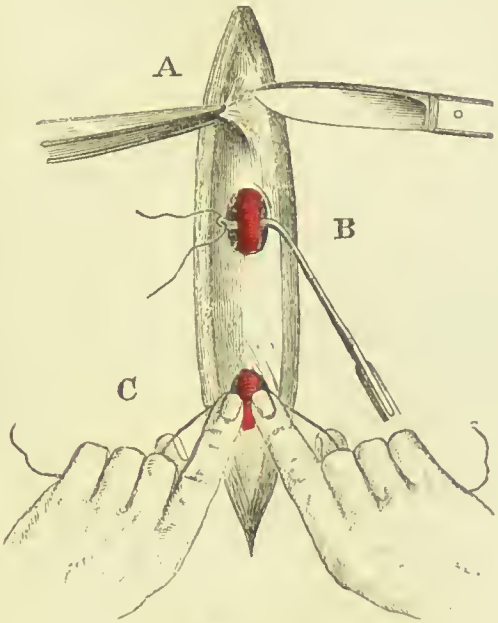
The first incision should include the skin and superficial fascia down to the deep fascia, and, in making it, the operator has only to avoid the division of any large vein such as the external jugular in operations on the neck; or, saphena, in operations on the thigh. He should, consequently, mark out their position by arresting the circulation through them on their cardiac side, and make his incision parallel with them when they lie in his course.

When the deep fascia is exposed, it should be laid open, and in this step, the use of a director is sometimes valuable; the fascia, moreover, should always be divided to the full extent of the external incision. The student should remember that the trunks of all arteries, except the cutaneous are covered in by fascia. With the division of the fascia, the use of the knife can for a time be dispensed with, as the intermuscular septa and cellular tissue are readily separated by the handle of the instrument or finger, so that the sheath of the vessel can be thus well exposed.

If, writes Malgaigne, "immediately after the first incision, the surgeon attempts to find the artery, he tries an impossibility, since he cannot reach it till after the last incision." He will then proceed uncertainly, and at random, hence the following rule of the guiding points:—"The surgeon should not at the commencement occupy himself with looking for the artery, but should seek the first marked point of guidance, then the second, then the third, and so on to the end."

In looking for the sheath every anatomical guide is to be made use of to prevent undue manipulation or separation of parts.

Fig. 146.



This diagram represents three distinct operations. A. Opening the sheath. B. Drawing ligature round the artery. C. Tying artery.

Fig. 147.



When the sheath is found and the pulsating artery is felt within, the end of the operation is not distant. Yet many errors may be committed. Every possible mistake should consequently be thought over beforehand in order to be avoided. The operator must ask himself as to the position of the nerves and veins about the part, so as to avoid them. He need not look for them as in a dissection, for this would necessitate superfluous manipulation, but their existence ought to be present in his mind. He should only remember their relative position to the vessel where the ligature is to be applied, and then guard against their being injured. The sheath having been found, it must be raised by the forceps and carefully opened (Fig. 146, A), such opening being only sufficient to admit a probe or aneurism needle, and the less the sheath is separated from its vessel the better. The needle (Fig. 147) with the ligature is then to be passed (Fig. 146, B), and it should be introduced between the artery and the vein, because when it is passed the other way the vein may be perforated or mistaken for fascia; yet in the hands of a careful surgeon this point need not weigh against convenience. With the exposure of the artery all anxiety ceases, for, to put an ordinary silk, wire, or catgut ligature around it is a comparatively easy task with the majority of arteries; so when this is accomplished, the operation, as such, is all but completed. To do this, however, the surgeon must be careful not to elevate the artery from its bed by the ligature, but to tie the knot with his fingers well passed

Opening of sheath.

Passing of needle.

Care in ligaturing.

down to the vessel (*vide* Fig. 146, c). He should also satisfy himself when the vessel is on the needle that pulsation exists, and that pressure arrests pulsation in the aneurism. When the ligature has been applied, the displaced parts must be readjusted, the wound cleansed, its edges brought together, and some light application employed, such as dry lint or water dressing. Where the artery of an extremity has been tied the limb should be raised to facilitate the venous circulation, and cotton wool wrapped round the part to maintain its heat, but, beyond this, no local treatment is required. It need hardly be stated that chloroform should invariably be given in these operations, and that the subsequent treatment of the case should be based on general principles. When veins bleed or large venous trunks require to be divided, they may be tied or twisted, though gentle pressure often arrests bleeding from small vessels. The wound should be carefully cleaned during the operation by the firm pressure of a well-squeezed sponge, the edges should be held apart after the sheath has been exposed by hooked directors, but the surgeon on no account should allow his assistants to draw the parts so far asunder as to make them lose their relative positions. With these general remarks, the application of a ligature to special arteries will now claim attention.

After-treatment.

Chloroform to be given.

Veins may be wounded.

Ligature of the Abdominal Aorta.

On ligature of the abdominal aorta.

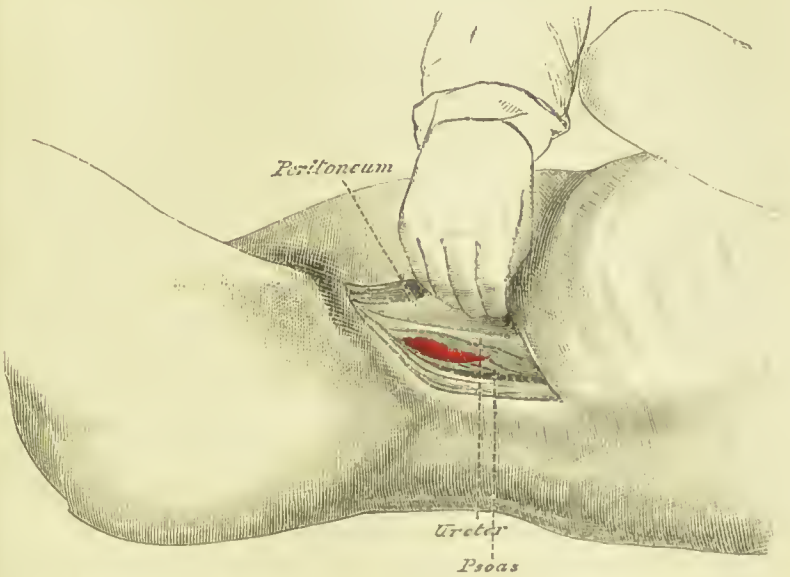
In 1817, Sir A. Cooper tied the abdominal aorta, having failed to find the communication between the common iliac artery and an aneurismal tumour, after the introduction of his finger through a small opening in the ruptured sac. He made his incision through the linea alba to the left of the umbilicus, directly over the aorta. The patient lived forty hours. James, of Exeter (1829), and Murray, of the Cape of Good Hope, followed his example with no better success, the patients surviving three and a half, and, twenty-three hours respectively. In 1842 ('Lancet,' p. 334) Dr. C. B. Monteiro, of Rio Janeiro, recorded a case, in which the patient died from hæmorrhage on the tenth day. In 1856 Mr. South ('Lancet,' vol. ii) operated on a patient who lived forty-three hours. In 1868 ('American Journal of Medical Science') Dr. McGuire, of Richmond, Virginia, recorded a sixth case, in which the patient lived twelve hours. In 1869 Dr. P. H. Watson, of Edinburgh ('Brit. Med. Journ.,' 1869) is said to have performed the operation on a man who survived it sixty-five hours; and in the 'Dublin Quart.' for 1869 Mr. Stokes, junior, has recorded an eighth case in which a temporary ligature was applied, but without success.

In all these, the operation was performed for aneurism of the common iliac artery, but the results up to the present offer little encouragement for its repetition, more particularly when we have other means at our command holding out a better promise of success, such as pressure by the abdominal tourniquet, while the patient is under the influence of chloroform. Cures of abdominal aneurism by this means have been recorded by Dr. Murray, of Newcastle-on-Tyne ('Rapid Cure of Aneurism by Pressure,' 1871), Dr. Heath, of Sunderland ('Brit. Med. Journ.,' 1867, p. 287), Mr. Holden ('St. Barthol. Hosp. Rep.,' 1866), Dr. Moxon and Mr. Durham ('Med.-Chir. Trans.,' 1872), and Dr. Greenhow, ibid., 1873.

Cure of abdominal aneurism by pressure.

I believe, nevertheless, the operation of placing a ligature upon the abdominal aorta to be justifiable under exceptional circumstances, such

Fig. 148.



Incision for the application of a ligature to the aorta or common iliac artery.

as in cases of aneurism of the common iliac artery when all other means are inapplicable.

The best incision by which to reach the abdominal aorta is the *indirect*, a modification of that adopted by Sir P. Crampton in the case of the common iliac artery (Fig. 148), viz., one extending from the anterior superior spinous process of the ilium of the left side to the cartilage of the tenth rib, the peritoneum being reflected. The great difficulty in this operation is in the application of the ligature to the vessel. The best *direct* incision is through the abdominal walls on the vessel such as is practised by Dr. Watson.

Ligature of the Arteria Innominata.

On ligature of the arteria innominata.

The first operation was by V. Mott, of New York, in 1818, and since then this artery has been tied twelve times, but only once with success (by Dr. Smith, of New Orleans, in 1864) and in that case the carotid and vertebral arteries were likewise ligatured, the former at the same time as the innominata, the latter a month afterwards for secondary hæmorrhage. D Smyth accomplished this on the suggestion made by Mott in 1818, when he wrote, "by thus intercepting the retrograde current through the primitive carotid there would be less chance of any reflux hæmorrhage in the event of a phagædenic ulceration taking place in the wound. In all the other cases a fatal result rapidly ensued. It can only be entertained, therefore, in cases of injury to the carotid or subclavian near their origin, or in exceptional cases of disease. When decided on, the operation should be proceeded with as follows—

Operation.—The head being thrown back to the left and the shoulder depressed, the vessel may be secured by making an incision along the anterior border and sternal origin of the sterno-mastoid muscle; or, by a transverse one over the upper border of the clavicle making its centre correspond to the upper border of the sterno-clavicular joint; or by both combined. Under all circumstances the sternal and sometimes a part of the clavicular, origin of the muscle will require division. The sheath of the cervical vessels will then come into view, with the internal jugular vein on the outer side of the carotid artery and the vagus nerve between them. On tracing these downwards the innominate vessel will be reached. In a healthy subject the artery is always to be found behind the right sterno-clavicular joint, but in disease, its relative position may be altered by mechanical displacement.

Cooper's operation.

Dr. Cooper, of San Francisco, has reached the artery on two occasions by removing the sterno-clavicular articulation.

On aneurism of the innominate.

In aneurism of the innominate there is no possibility of applying a ligature to its cardiac side, even if the disease involves only the upper part of the artery; yet as a rule this form of aneurism is almost sure to be associated with dilatation of the aorta. The distal operation, however, may be thought of, the carotid and subclavian arteries being ligatured simultaneously or consecutively. Of five instances in which the former practice was followed one (Ensor's case, 'Lancet,' July 31, 1875) lived sixty-five days, and one recovered; while out of three of the latter an equal success may be recorded.

Brasdor's or Wardrop's.

The credit of the successful case in the former class, for a success I take it to have been, belongs to Mr. C. Heath, who tied the subclavian artery in the third part of its course as well as the common carotid simultaneously in 1865. The operation was followed by marked relief, and the diminution of the tumour; the woman, æt. 30, survived the operation four years, and died from rupture of the aneurism. After death the aneurism was found to be of the aorta, the innominate being only slightly involved. (*Vide* Prep. in Mus. of Royal Coll. of Surgeons, and 'Path. Trans.,' vol. xxi).

The successful issue to the case in the latter class belongs to Mr. Fearn, of Derby, who tied the carotid in 1836, and the subclavian in the third part of its course two years later, for innominate aneurism. The patient died four months after the second operation from pleurisy. I had an opportunity in 1866 ('Path. Soc. Trans.,' vol. xviii) of carefully examining and reporting on this preparation which is now in the College of Surgeons' Museum, and a better specimen of a cured small accumulated aneurism could not possibly be seen.

Aneurism of the innominate has likewise been treated by ligature of the subclavian or of the common carotid alone, Wardrop's operation; and in 'Holmes's Surgery' a most interesting list of references to such cases, collected by Mr. Heath, can be found. Out of eighteen, Evans's case, as recorded by Wardrop, was cured; his own lived two years; Morrison's case lived twenty months, two others lived six months, and the remainder lived only a few days or weeks.

In August, 1871, I ligatured the subclavian in a man æt. 33, for this affection, and a rapid convalescence followed, with great diminution and consolidation of the aneurism. The man lived three years after the operation (*vide* page 455). This result, therefore, not so discouraging as to preclude the question of operation in favourable cases.

It should only be entertained, however, under exceptional circumstances, and more as a palliative than a curative remedy.

Ligature of the Common Carotid Artery.

Ligature of the common carotid.

This operation was first performed for aneurism by Sir A. Cooper in 1805, but unsuccessfully. The same surgeon, however, had a successful case in 1808, the man surviving thirteen years ('Guy's Hosp. Rep.,' vol. i). The operation may be demanded for aneurism or erectile tumours of the trunk itself or one of its branches, in the orbit, on the scalp, &c., and for wounds or hæmorrhage. It may also be called for as a distal operation in aortic aneurism. It is a dangerous and sometimes a difficult operation, but in a moderately thin subject it may be performed with facility. It should only be resorted to when all other means of treatment are inapplicable or have been found ineffectual; for aneurism it ought not to be performed unless the treatment by digital compression has been rejected. Holmes well sums up the matter in his College Lectures, 1873, as follows:—"That the experience of surgeons hitherto leads to the conclusion that aneurism of the trunk of the carotid artery may be very often treated successfully by compression, and that the cure by compression frequently leaves the artery unobliterated, and therefore exposes the patient to a far less risk of cerebral mischief than the ligature; that the ligature of the carotid for such tumours is extremely dangerous and ought not to be undertaken until attempts, well devised and perseveringly carried out, have failed to effect the cure by compression; and that when the surgeon has been compelled by the position of the tumour to place his ligature close to the proximal side of the sac, it is worth very great consideration whether it would not be better to evacuate the tumour, and tie the distal part of the artery also; finally, that cases do occur in which Brasdor's method holds out a rational hope of cure, but that this operation ought not to be practised except in cases of growing aneurism, when digital pressure checks the pulsation of the tumour, yet has failed to effect a cure." ('Lancet,' June, 1873.) The vessel may be ligatured in the upper part of its course at the apex of the carotid triangle, in a line with the cricoid cartilage, or, it may be ligatured lower down; the former position is the preferable and more easy, and for disease of any of the branches of the vessel should be selected. The latter should only be resorted to for disease or wound of the upper part of the trunk itself. The course of the artery can always be made out, corresponding as it does with a line drawn from the sterno-clavicular joint to the angle of the jaw; it divides at a line on a level with the upper part of the thyroid cartilage, and should be tied opposite the cricoid. The centre of the incision should consequently correspond to this point, and should extend about three inches along the anterior margin of the sterno-mastoid muscle. The position of the patient should therefore be such as to render this muscle prominent, which is ensured by the extension of the head backwards, the face being turned to the opposite side.

Place of selection.

Before making the first incision through the skin, platysma, and superficial fascia, the surgeon should assure himself that no large vein, such as the anterior jugular, is likely to be divided; gentle pressure below, enough to interfere with the venous circulation of the part, readily supplies this information. The deep fascia covering in the sheath

Description of operation.

of the vessel may then be divided, care being taken to do this to the whole extent of the external wound. The sheath of the artery will then come into view, lying between the trachea and sterno-mastoid muscle; the pulsation of the vessel likewise can be detected. The head of the patient at this stage of the operation should be slightly raised, so as to relax the sterno-mastoid muscle and allow its being gently drawn out by means of the retractor, as well as to permit of the separation of the cellular connective tissue of the part. The anterior belly of the omo-hyoid muscle will then probably be at once visible with its fibres passing downwards and outwards, and, when this muscle is broad it will cover in a great part of the vessel. The descendens noni nerve may likewise be seen lying upon the sheath, or sometimes within; due care being taken that it is not wounded or included in the ligature; and if it be in the way, it must be gently held aside by a retractor, as also any large vein that crosses the sheath. The inner border of the sheath is then to be taken up and firmly held with forceps, a sufficient opening being made in it by the knife held with its flat surface towards the artery, to allow of the introduction of the aneurism needle; the needle is then generally recommended to be passed *armed*, though this is not a point of importance, while *unarmed* it is passed with greater facility; then by a little manipulation the needle may be passed round the artery from without inwards, introducing it between the vein and vessel, its point being kept close to the artery. The sheath may then be dropped from the forceps, the loop of the ligature seized or the needle threaded, when it should be withdrawn. The surgeon must, however, satisfy himself beforehand that the right vessel had been exposed, and that the vagus nerve is not included. The vessel can now be tied, great care being observed that it is not raised from its bed or manipulated more than is necessary; the knot should be tightened by the index fingers passed well into the wound. The wound should then be adjusted and the patient put to bed, the most perfect quiet being enjoined. The surgeon ought to remember all through this operation that the jugular vein is on the outer side of the artery, and often overlaps it; while the vagus nerve is behind, and the descendens noni in front (Fig. 149). None of these parts need be looked for, however, so long as care is observed that they are neither wounded nor included in the ligature.

Ligature of carotid in lower part.

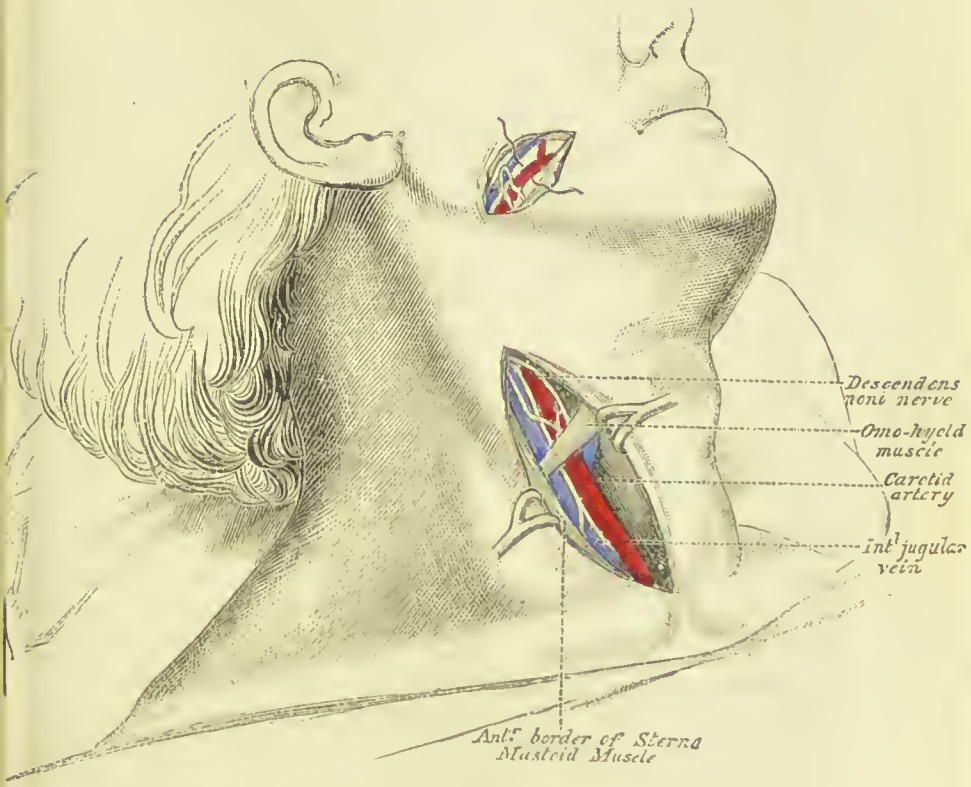
The operation for ligaturing the *lower part of the carotid* is somewhat similar to the above, the operation being more difficult from the vessel being deeper, particularly on the left side. The incision should in this instance extend lower down over the sterno-clavicular articulation. The muscles will also require more retraction, and probably some division. The ligature when of a permanent nature, will probably separate about the fifteenth day, but occasionally the period will be longer; the less it is disturbed the better, the gentlest traction only being applied to draw it out of the wound. If its discharge be retarded, the ligature may be twisted daily on its own axis, to facilitate its separation, yet this should be done with extreme caution.

Key's case.

Mr. Cock related to me a case, which he authorises me to quote, in which Mr. Aston Key applied a ligature to the left carotid for aneurism and the man died on the table; indeed dying on the application of the ligature. After death it was found that the right carotid had been previously obliterated, and the operator had, by ligaturing the left, so interfered with the supply of blood to the brain as to cause death.

Such a case as this is unique, and deserves a place in the records of our profession.

Fig. 149.



(This figure, with many others in this chapter, is based upon those given in Sedillot's work.)

Prognosis of ligaturing in common carotid.

With respect to the prognosis after this operation, much depends on the object for which it is performed. Dr. Pilz, of Breslau, whose statistics are the most recent ('Langenbeck's Archives,' 1868), makes out that 43 out of every 100 die. He says that of 228 cases in which the operation was performed for hæmorrhage, 128, or 56 per cent., were fatal; of 87 for aneurism, 31, or 35 per cent., died; of 142 for tumours, 49, or 34 per cent., died; of 71 for extirpations, 25 died. or nearly 34 per cent.: of 34 for affections of the nervous system, only one died, or 3 per cent.; and of 38 for aneurism, on the distal or Brasdor's method, 25 died, or 65 per cent.

Secondary hæmorrhage is a common cause of death, but brain complications are the more frequent—abscess in the brain and atrophic softening from want of arterial supply being the usual form—local gangrene, as it were, of the brain. Brain symptoms in some of their forms also occur frequently after the operation, when death does not take place simply from altered cerebral circulation. Suppuration of the aneurismal sac is not unfrequent; and in a case of my own it was the cause of death.

Ligature of external carotid.

Ligature of the external or internal carotid artery is rarely performed, the ligature of the common trunk being preferred. In certain wounds of these arteries near their origin, a ligature may, perhaps, be placed upon them, but the uncertainty of the position of the bleeding point renders the ligature of the common trunk preferable. In the 'New York Med. Journal,' January, 1874, a case is recorded by Dr. H. P. Sands, of New York, of successful ligature of the internal carotid artery above and below the bleeding point for secondary hæmorrhage occurring ten days after the removal of a cancerous tumour. Cervical aneurisms situated on one of the secondary carotids should be diligently treated by compression, and the Hunterian operation only performed when treatment by compression has failed.

If the surgeon is required to tie the external carotid, he may do so by adopting the same rules as have been laid down for the common carotid, although the incision should be made a little higher. The course of the vessel follows the same line as the common carotid, commencing at the upper part of the thyroid cartilage.

Ligature of the lingual artery.

The lingual artery has been ligatured for wounds of the tongue and of the artery itself, to check the growth of cancerous tumours, or to arrest hæmorrhage from their substance. The operation is difficult. The trunk of the vessel is always to be found at a point *above the great cornu of the hyoid bone,* and this point must be rendered prominent by the head being well drawn over to the sound side. The best incision is horizontal on a level with the hyoid bone, its centre corresponding to the end of the greater cornu. The skin and facia having been divided, the submaxillary gland will become exposed. On hooking this upwards and dividing the border of the mylohyoid muscle the hypoglossal nerve will be seen resting on the hyoglossus muscle. Beneath this muscle and at a lower level than the nerve, the artery will be found. It is in close contact with the tendon of the digastric muscle. The fibres of the hyglossus will always require division to admit of the ligature to be applied. Fig. 150 illustrates these points.

An excellent paper on this subject, by M. Demarquay, may be referred to ('Gaz. Méd. de Paris,' 1867).

Ligature of the facial artery.

The facial artery is always to be found in the greater part of its course close to the anterior border of the masseter muscle, where it is only covered in by skin, platysma, and fascia; and, at this part, a transverse or oblique incision at the lower insertion of the muscle will expose the artery, where it can be ligatured (*vide* Fig. 149). It is difficult to understand under what circumstances this operation can be called for, as the artery can be so readily controlled by pressure, an acupressure needle and twisted suture over it being the best form to employ. But, where the artery comes off from the external carotid and lies in the submaxillary gland beneath the jaw, it is somewhat deep, and an operation for its ligature by no means easy. I have, however had only one opportunity of practising this operation, and it was on a lady æt. 25, who was suffering from a cirsoid aneurism of the vessel as it passed through the submaxillary gland. The operation was successful. I saw the case with Dr. Helsham, of Brixton.

Ligature of the temporal artery.

The temporal artery can always be found and pressed upon in front of the pinna of the ear, over the zygoma. It lies buried in the dense cellular tissue which exists in this spot beneath the skin and fascia, and

ean readily be exposed by a vertieal or oblique incisiou an inch long, one third of an inch in front of the tragus.

The occipital artery ean be traeed by a line drawn from the mastoid proeess to the oecipital protnberanee, aud lies beneath the skin and erauial aponeurotic origins of the sterno-mastoid and splenius traehelo-mastoid and digastric museles, whieh must be divided to reaeh the vessel in the deep part of its course. The artery ean be felt about the eentre of the line mentioned. Ligature of the occipital artery.

Ligature of the Subclavian Artery.

This operation in the *first part* of the vessel's course has been performed twelve times, but never with suceess. It is an unseientifie as well as au unsuccessful operation, and, for disease, it is seareely a justifiable proceeding, though for a wound it may perhaps be entertained. The ineision for the operation would be similar to that for the innominate. Ligature of the subclavian artery

The point nsually seleeted for the application of a ligature to the subclavian is in the *third part* of its eourse, where the artery emerges from behind the sealenus musele. This operation may be demanded for aneurism of the axillary artery or for a wounded vessel. Place of selection.

Aneurism may affeet the subelaviau artery in any part of its eourse; it may involve the whole of the artery, or be eonfined to its first or third portion. When situated on the artery to the inner side of the scaleni museles, it may be mistaken for an innominate or aortic aneurism; or a common aneurism may involve all these vessels on the right side of the body. When affeeting the artery external to the scaleni, it is most frequently assoeiated with disease of the axillary artery. On subclavian aneurism. Its seat.

The diagnosis of subelavian ancurism is consequeutly by no means easy, and is thus referred to by Nélaton: Its diagnosis.

"In subclavian aneurism the tumour extends generally externally to the elavieular origin of the steruo-mastoid musele, reaching the posterior and iuferior triangle of the neek; beeomes more elongated transversely than vertieally; the bruit is propagated more towards the axilla than the neck, and remains the same on eompressiug the carotid; the radial pulse enfeebled; the limb painful and œdematous, and iucommoded in its movements. In carotid aneurism the tumour is seated between the sternal and elavieular origius of the sterno-mastoid muscle, beeomes more elongated iu a vertical direetion than in a transverse oue, and on ausenltation gives to the ear a *bruit de souffle*, whieh is propagated more towards the side of the neck than the arm, with dimiuution of the arterial pulsatiou in the eorresponding side of the faee and eraninm, and without weakening the radial pulse on the same side. In innominate aneurism the tumour is plaeed uuder the sternum, or at the inner border of the sterual portion of the sterno-mastoid muscle, with weakening of the pulse in the subelavian and carotid arteries, and with absenee of the other signs peeuliar to the two other forms."

The prognosis must always be regarded as unfavorable, for these aneurisms are peculiarly liable to beeome diffused even in the early stage of their development as a visible tnmour; yet there are several instauees on reeord of their slow progress, and, some fortunate examples of their ultimate eure by natural efforts. Its prognosis.

THE TREATMENT of these aneurisms is most unsatisfaetory, the space at the disposal of the surgeon being so limited that he is at a loss to Its treatment.

Ligature.

know where he can attack the disease by the few means that are at command. Ligature of the first portion of the subclavian, ligature of the innominate, the distal ligature of the subclavian and axillary arteries, and ligature of the carotid, have all been performed, and, with one exception, been attended with fatal results. The exceptional case is that of Dr. Smyth, of New Orleans, who tied the innominate and carotid, and subsequently the vertebral artery on the fifty-fourth day. It is only in small aneurisms, occupying the third portion of the artery and the commencement of the axillary, that the operation of tying the subclavian external to the scaleni has been successfully performed, and, in some of these instances, the outer fibres of the scalenus anticus muscle have been obliged to be divided.

Amputation.

The amputation at the shoulder-joint on the distal side of the aneurism has been suggested by surgeons for the cure of the disease. It has too been successfully performed by Professor Spence, of Edinburgh.

Galvano-puncture.

Manipulation.

Galvano-puncture has been successful in one case by Abeille; and *escharotics* in another by Bonnet. *Manipulation* has been employed by Fergusson in two cases, and by Lidell in one case, with satisfactory results in the latter one only. A case of Porter's may also

Compression.

be accepted as successful. *Direct compression* of the aneurism has been tried by Warren with a favourable issue, although much danger was risked in the proceeding. Corner's case ('Med.-Chir. Trans.,' vol. lii), though one not actually of the same kind, was a very good instance of the value of preventiug an aneurism from enlarging, and exerting such moderate compression as to incite fibrinous deposition in the interior of the sac. Poland's case of successful *pressure on the artery* on the cardiac side of the aneurism is quite exceptional. Gay also has recently met with success. The use

Acupressure.

of *acupressure* by Porter, though successful on the distal side of the aneurism, proved fatal when applied on the cardiac side to

Injection into sac.

Hypodermic injection.

the innominate artery, and *injection into the sac* was performed in one case with a fatal result. Langenbeck has recently injected the parts over the aneurism with a *solution of ergotin*, the object being to cause contraction of the aneurismal sac. Such is a list of the means which have been resorted to, but the success has never been great. The question naturally arises, therefore, whether we should not discard such measures, and treat these aneurisms on the ordinary principles of internal aneurisms, by rest, attention to diet, and medicinal remedies.

Statistics of the treatment of subclavian aneurism.

Mr. Poland, in an admirable essay in the 'Guy's Reports' for 1870, gives a very favorable return of cases which he has been able to collect in reference to this point. It stands thus:

Out of 13 that underwent *general and local treatment* 7 recovered, 1 was relieved, and 5 died; out of 22 cases in which an expectant treatment only was pursued, 4 recovered and 18 died; thereby giving a total of 11 recoveries and 23 deaths, 1 being relieved. Of the 23 fatal cases, the duration of life was noticed in 17.

In 21 cases in which the subclavian artery was ligatured in the *third part of its course* for aneurism, 9 recovered (in 6 of these it was the left artery that was ligatured), and 12 died: 8 of the deaths were due to hæmorrhage, and 4 to brain complications or other symptoms. Poland's facts thus accord well with Koch's, who gives 36 recoveries out of 65 cases, something less than half dying, a success, which is certainly encouraging to induce surgeons to undertake the operation.

The operation.—It has been already stated that the application of a ligature to the subclavian in the first part of its course is scarcely a justifiable operation; but when undertaken, the incision on the right side would be similar to that for the innominate; on the left side it is scarcely practicable on account of the depth and relations of the artery. Ligature of first portion of subclavian.

In the *third part* of its course the operation should be performed as follows (the method being similar for both sides). The patient should be raised on a pillow with his head thrown back and face turned to the opposite side, an assistant drawing the arm down as much as possible to depress the shoulder. An incision three or four inches long should then be made on the upper surface of the middle of the clavicle (Fig. 150); not above the bone, as the external jugular vein might then be wounded. Some surgeons advise the skin to be drawn down from the neck upon the clavicle, so as to diminish this risk. In this incision the skin with the superficial fascia and platysma will be divided. The deep fascia is then seen with the external jugular vein coursing over it. This must be held aside with a retractor, When its division is a necessity, it should be done after the application of two ligatures, one above and another below the line of section. The cervical fascia can then be divided the whole extent of the wound, which must be done with care on a director; and should more room be wanted, a portion of the sterno-mastoid or trapezius muscle may be divided. The knife is now to be laid aside and the artery looked for in the space exposed, the parts being separated by a director or the handle of the scalpel. The vessel will be found just on the outer side of the scalenus anticus muscle (the edge of which can generally be felt) and behind the tubercle on the first rib, a point which can almost always be made out. Several arteries of large size will probably be found crossing this space, as well as many veins. The supra-scapular artery and vein will always be seen behind the clavicle. The brachial plexus lies above and behind the subclavian artery, the subclavian vein in front and below. When the vessel is seen or felt, the sheath is to be opened and the aneurism needle passed around it from above downwards, care being taken not to injure the vein or include a nerve. Ligature of the third portion of the subclavian.

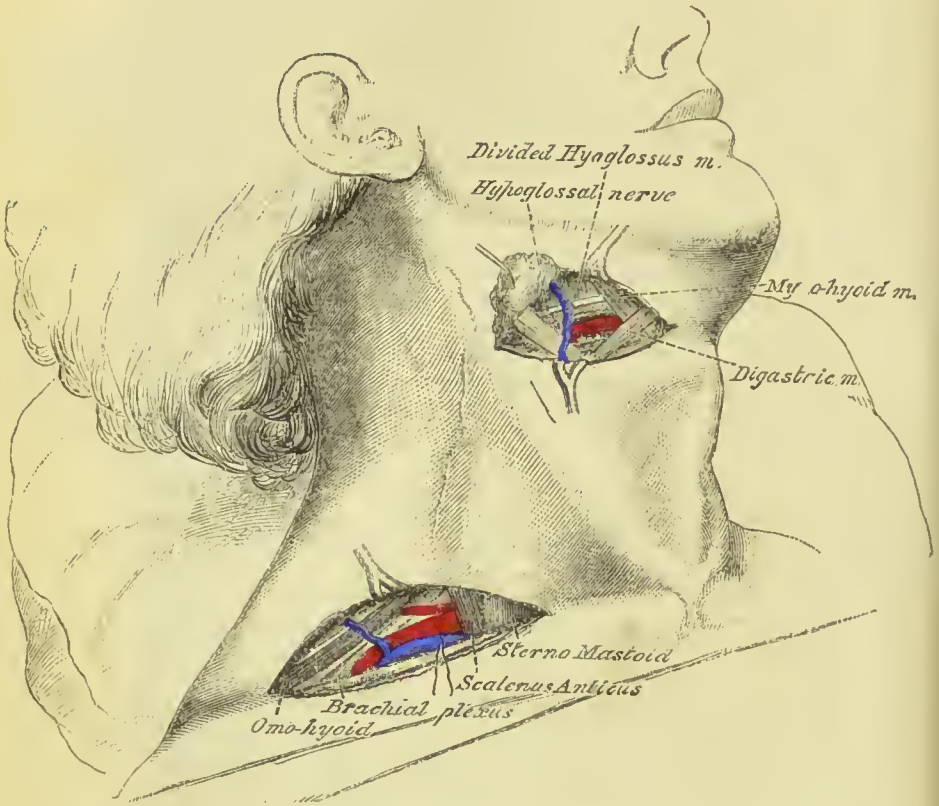
Ligature of the Axillary Artery.

This is a rare operation, although it may be demanded for some wound of the vessel, or, for aneurism of the brachial. It may be performed in two positions, either immediately below the clavicle, or, in the axilla. Ligature of the axillary artery.

The subclavicular operation is carried out by an incision made immediately below the bone from the coracoid process to its sternal end, dividing integument and fascia, yet carefully avoiding the cephalic vein that runs along the anterior border of the deltoid to join the axillary. The clavicular origin of the pectoral muscle may then be divided, and the deep fascia or costo-coracoid membrane covering in the sheaths of the vessels will be exposed and divided. In this step of the operation, some of the branches of the thoracic acromial artery will come into view, and if wounded, must be secured. The coracoid insertion of the pectoralis minor can also be seen. The fascia covering in the vessels will then be exposed, and on laying it open the greatest care is necessary as the axillary vein lies immediately beneath it, while above will be found the vessel resting on the first intercostal muscle. The brachial plexus is above and behind. The axillary vein should be drawn downwards and The subclavicular operation.

the aneurism needle passed from below upwards, care being taken not to include the external respiratory nerve of Bell that passes behind the artery. When the vessel has been exposed, the passage of the liga-

Fig. 150.



Ligature of subclavian and lingual arteries.

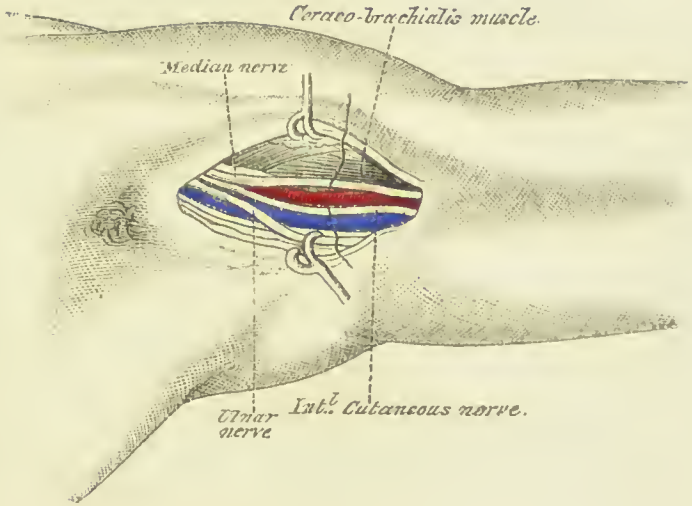
ture will be facilitated by bringing the arm down to the side of the body. On the dead subject this operation is not difficult, but the number of veins and arteries that exist in the space must ever render the operation on the living far from easy.

Ligature of the artery in the axilla.

To tie the axillary artery in the axilla, the arm should be well raised upwards, and the course of the vessel marked out slightly posterior to the middle line of the axilla. An incision should then be made along the inner margin of the coraco-brachialis muscle through the skin and fascia for about two or three inches, and the deep fascia exposed. This should be carefully divided to the whole extent of the wound, when the artery with its attendant nerves and veins will come into view. In this stage of the operation, the forearm should be flexed on the arm to relax the parts. The vessel, as a rule, has the median nerve on its outer side and nearer to the pectoralis major muscle, and the vein and ulnar nerve to its inner side. The internal cutaneous nerve is in front. (*Vide* fig. 151.)

Mr. Guthrie condemned the subclavicular operation altogether, and

Fig. 151.

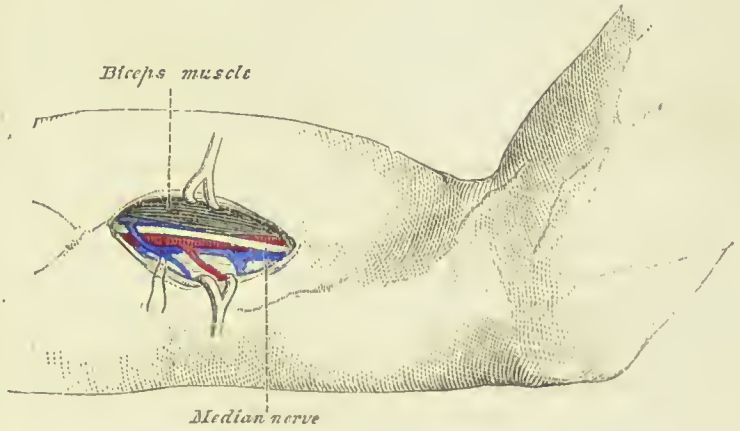


Ligature of axillary artery.

To face page 480.

advised the surgeon to expose the artery by an incision three inches long, carried upwards along its course, commencing at the lower Guthrie's opinion.

Fig. 152.



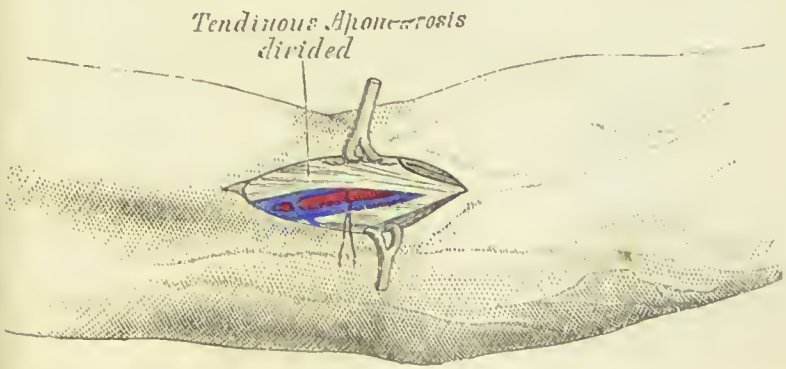
Ligature of brachial artery.

border of the pectoral muscle; yet few have followed this advice, most surgeons preferring the operation named subclavicular, one of its modifications, or the ligature of the subclavian. Mr. Erichsen for the superior operation prefers an incision made from the centre of the clavicle downwards in the course of the vessel to the middle of the anterior fold of the axilla, such incision necessitating the division of the great pectoral muscle, and often of the small. He says "that this division need not leave any permanent weakness of the limb, as by proper position ready union may be effected between the parts." Erichsen's views.

In all these operations on the axillary artery, the surgeon must ever be on the outlook for abnormal division and relations of the vessel.

Ligature of the brachial artery may be demanded for direct injury to the vessel, hæmorrhage from a wound of one of its divisions in the Ligature of the brachial artery.

Fig. 153.



Ligature of brachial artery.

hand or forearm which cannot be treated locally, aneurism, &c., and can be performed readily in any part of its course. The middle of

the arm is the best point to choose. The course of the vessel is indicated by a line drawn from the middle of the axilla to the inner side of the biceps tendon at the bend of the elbow, while the inner border of the biceps muscle is the guide to the incision. The vessel may be exposed by a cut, two to three inches long, made in this position, with the arm extended and supinated. The skin, which is always thin, and the fascia should be carefully divided, and the deep fascia which is thus exposed ought then to be laid open, but with care, for the basilic vein lies immediately below it on the inner side of the brachial artery. The ulnar nerve will be found on the inner side of the vein, and the median in front of the artery, but there is no regularity in these relations; consequently much care is required in finding the vessel and discretion in tying it, for a high division of the vessel or the existence of some vas aberrans may mislead and confuse. When the right vessel has been found, the application of a ligature is readily concluded. In performing this operation care must be taken not to open the sheath of the biceps muscle, and it should be remembered to flex the forearm on the arm, after the division of the deep fascia has taken place. In several cases in which the occlusion of this artery was required, I have divided it and torsed both ends with excellent results.

Description of the operation.

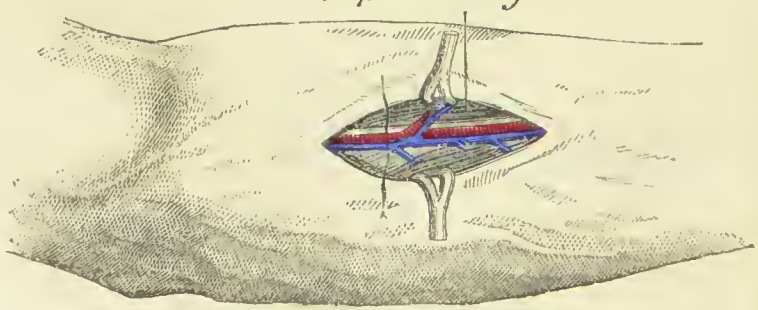
Ligature of the lower third.

Ligature of the brachial in its lower third is now rarely performed. In the days of bleeding, it was by no means unfrequently required for traumatic aneurism, though it has never fallen to my lot to witness its performance for such a cause. The operation may be performed with the forearm extended, by making an incision two and a half inches long on the inner side of the tendon of the biceps, care being taken to avoid the large veins that ramify in the superficial fascia. The tendinous aponeurosis of the biceps will then come into view, and, on its division, the artery will be exposed with its venæ comites—the tendon of the biceps being on its outer and the median nerve on its inner side. The forearm should then be flexed after the artery has been exposed, when a ligature can be passed without trouble.

Ligature of the radial artery.

Ligature of the radial artery.—A line drawn from the *outer* side of the biceps tendon, at the bend of the elbow to half an inch internal to the styloid process of the radius at the wrist, marks out with sufficient

Fig. 154.



Ligature of radial artery.

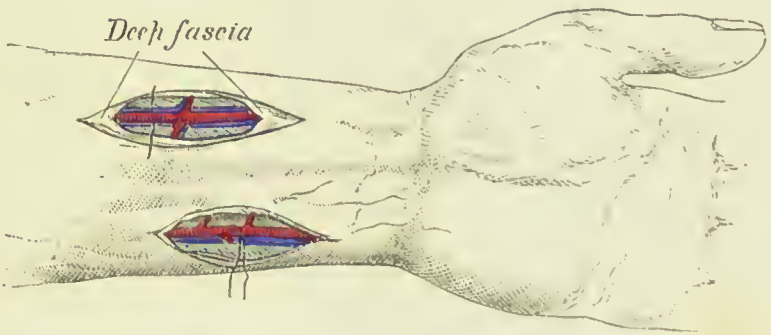
clearness, the course of the radial artery, and the vessel may be tied in any part of it. In the upper third of the forearm (Fig. 154), between

the supinator longus on the outer and pronator teres on the inner side, it can be found by an incision two inches long made in the line above mentioned, dividing the integument and deep fascia, care being taken not to divide the large cutaneous veins unnecessarily. On separating the muscles with the handle of the knife, the forearm being partially flexed, the artery will be brought into view with its venæ comites, the nerve being to its outer side. A ligature can then be easily passed round the vessel. I have had to cut down upon the radial artery in this part of its course for a traumatic aneurism the result of a punctured wound, when I divided the vessel and twisted both ends, convalescence speedily following.

At its lower third.

At the lower third the vessel may be found external to the flexor carpi radialis muscle, but internal to the supinator longus. It lies beneath the deep fascia, and, on the division of this, the artery can readily be found (Fig. 155). On the dead subject, the principal cause of difficulty in applying the ligature lies in the fact, that students look for the artery too superficially, mistaking the superficial radial vein for the deep. I have had to ligature or twist the radial above the wrist on seven occasions for aneurism; in six for traumatic aneurism situated

FIG. 155.



in front of the wrist, and in the other for aneurism on its dorsal end. In all a good result ensued.

Ligature of the ulnar artery.

Ligature of the ulnar artery.—This vessel lies beneath the superficial layer of muscles in the upper half of its course, and, in the lower, it is found between the tendons of the flexor carpi ulnaris on the inner side and flexor sublimis digitorum on the outer, being covered with integument and deep fascia. Its position is roughly indicated by a line drawn from the inner side of the biceps tendon to the radial side of the pisiform bone, the upper part of the vessel describing a curve with the concavity outwards.

To ligature the artery in the upper half of its course, an oblique incision must be made crossing the line above indicated, and the radial border of the flexor carpi ulnaris should be found. Through this the incision must be made, when the artery will be seen between the two layers of muscles. This operation is very difficult and uncertain, and it is an open question whether it ought to be performed. I am disposed to think, that the brachial under all circumstances ought to be tied rather than have recourse to it.

To tie the ulnar above the wrist is not more difficult than to tie the radial (Fig. 155). An incision along the outer side of the flexor carpi

ulnaris, dividing skin, superficial and *deep* fascia, exposes the vessel, with its venæ comites, and the nerve on its inner side. A ligature can easily be passed round it. The drawings well illustrate these points.

Hæmorrhage from the palm of the hand, and its treatment.

Hæmorrhage from the palm of the hand is always alarming and troublesome, more particularly from a punctured wound. In a superficial incised wound the vessel may generally be found and ligatured or twisted, but, in the case of a deep wound, it is neither expedient nor justifiable to cut into and explore for such a purpose.

When the vessel cannot be tied, a graduated compress may be applied over the wound and the fingers flexed and bound down over a ball or block of wood, the arm being well raised in a vertical position. This dressing should not be undone for at least five or six days. If these means fail, which they rarely do when efficiently employed, the radial and ulnar arteries may be compressed with acupressure needles, and should this prove unsuccessful, the application of a ligature to the brachial artery may be required. In neglected cases where the parts are all infiltrated and boggy, this practice may be called for at once. It is well, however, before resorting to this practice, to try extreme flexion of the forearm upon the arm, with forced supination of the hand, with or without a pad at the bend of the arm; as it is now well known, that by this position the circulation through the brachial artery can be completely arrested; indeed, under all circumstances, whether for injury or disease of the arteries of the hand and forearm in which surgical interference is requisite, it would be well to remember this treatment, it being most effective. It should be known, however, that repeated hæmorrhage may take place from the palm of the hand from the presence of a sloughing tendon. In illustration of this I may mention a very interesting case I had with Dr. Bunny, of Newbury, where a gentleman, æt. 33, had his middle finger bent back so forcibly by a cricket ball as to cause rupture of the integument in front of the extreme joint, and laceration of the flexor tendons of the finger about the wrist. Suppuration and sloughing of the tendons followed, attended by repeated attacks of palmar hæmorrhage, which ceased at once on the removal of the dead tendons.

Ligature of Arteries of the Lower Extremity.

The External Iliac Artery.

Ligature of the external iliac artery. When applicable.

This operation may be required for aneurism of the common femoral artery, or for any other affection in which it is necessary to arrest the flow of blood through the lower extremity. It should not, however, be performed for any disease unless pressure of the artery, digital or instrumental, has proved ineffectual or is inapplicable, for Mapother ('Dub. Med. Press,' 1865), Eck ('St. Barthol. Hosp. Rep.,' 1866), and Hilton ('Med.-Chir. Trans.,' 1869) have all recorded instances of cure of inguinal aneurism by these means. The operation of ligature is, however, a successful one, and Norris and Cutter give forty-seven fatal cases out of 153 ('Am. Jour. Med. Sci.,' 1847 and 1864). I have performed it on six occasions, and in all with success. The course of the vessel is clearly indicated by a line drawn from the left side of the navel where the aorta bifurcates, to the middle of Poupart's ligament—the upper third of this line corresponding to the common iliac, and the lower two thirds to the external.

Statistics of the operation.

Course of vessel.

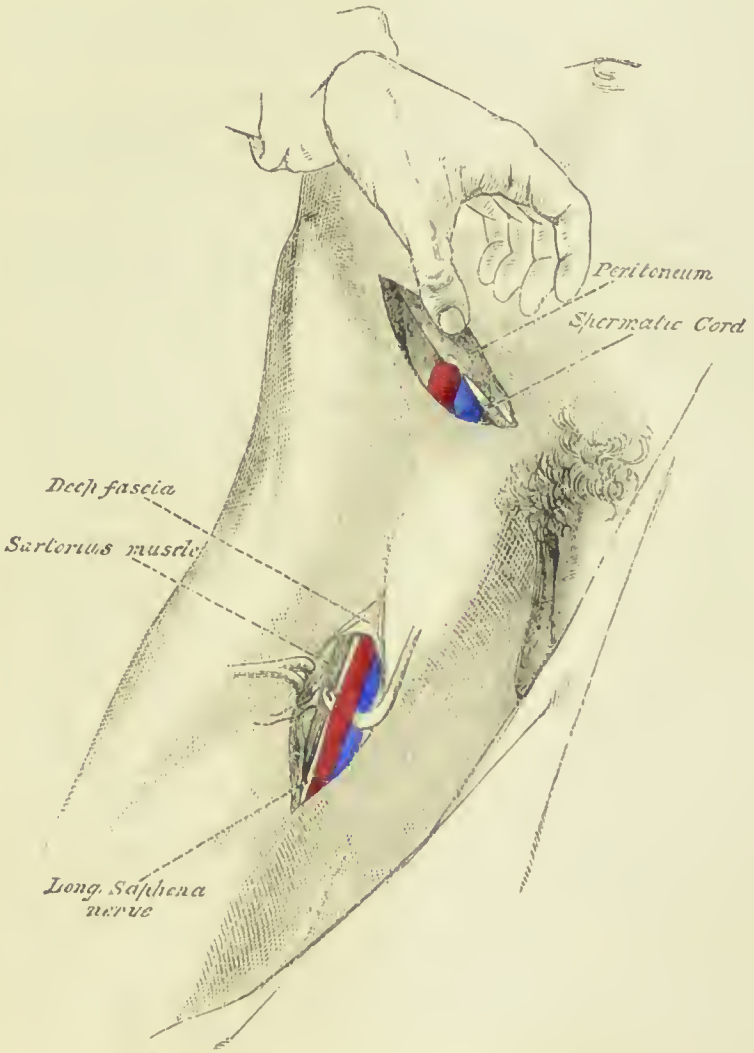
Abernethy's operation.

Abernethy, in 1796, was the first to ligature the vessel. The in-

cision he practised was vertical in the course of the artery, beginning an inch above Poupart's ligament. The peritoneum, however, is too much disturbed by this proceeding, as well as the abdominal walls weakened. The best incision is that employed by Sir A. Cooper, a slightly curved one, about half an inch above Poupart's ligament, and to the inner side of its centre, curving upwards and outwards for about three inches towards the anterior superior spine of the ilium. (Fig. 156.) This incision should divide all the soft parts superficial to the external oblique muscle. All vessels that are divided should be secured.

Modern incision, and description of the operation.

Fig. 156.



Ligature of external iliac and superficial femoral arteries.

The tendon of the external oblique muscle should then be divided the whole length of the skin wound, together with the internal oblique and transversalis muscle when they cannot be drawn outwards, and care should be taken not to injure the peritoneum; the cord

which then comes into view should be drawn inwards and the parts held well aside by hooked retractors. With the fingers, the transversalis fascia should be torn through from Poupart's ligament, the peritoneum raised upwards, and the sheath of the vessel exposed, the vein being to the inner side of the artery. By means of a director and forceps, the sheath can readily be opened and a ligature passed, the needle being introduced between the vein and artery. To divide the transversalis fascia, the whole length of the wound, is an unnecessary and dangerous proceeding; but to deal with it as suggested above is an extra protection to the peritoneum, and in no way renders the operation more difficult; indeed, I have been led to believe, that it facilitates the operation. It certainly does this on the dead subject, and in the six cases in which I have been called upon to perform it on the living this opinion was confirmed. The genito-crural nerve, which lies upon the vessel, should not be included in the ligature. The operation, however, is only applicable for tumours situated below Poupart's ligament; for others, Aberuethy's operation, or that suggested for the common iliac, should be selected.

Ligature of the common iliac.

Ligature of the common iliac artery has been performed about thirty-nine times, and only ten times with success. It was first successfully performed by Mott, of New York, in 1827. I have seen it done but once, and then by my colleague Mr. Cock in 1863, on a man æt. 27, and also with success.

To expose the vessel, the incision must be long, its length being determined by the size of the aneurism and depth of the artery. A curved incision commencing outside the internal ring and passing upwards and outwards as for the external iliac artery, appears to be the best, the muscles being divided to an equal extent. The transversalis fascia must be laid open or torn through and the peritoneum turned upwards. It is at this part of the operation that the greatest difficulties arise, for as soon as the transversalis fascia is divided, the peritoneum covering the intestine bulges into the wound. This membrane also is frequently found adhering to the aneurismal sac, and much difficulty is felt in separating it. This was markedly so in Mr. Cock's case. The oozing of blood into the wound also masks the vessel. The depth of the wound, likewise, renders the application of the ligature a matter of great difficulty. Nevertheless, these difficulties can be overcome by care and good aids. The operation is similar to that last described, though more difficult. In 1846, Mr. Stanley ligatured the common iliac artery by an operation suggested by Sir P. Crampton, and described by Skey.—The patient was placed upon his side, and an incision made from the end of the last rib downwards and forwards in front of the iliac crest, the transversalis fascia was divided, and the peritoneum rolled up. The common iliac artery was then found and tied with apparent facility. On the dead body, this operation is far from difficult, and promises to be of service to the living when the aneurismal tumour is large and high up. Indeed, it is probably the better operation of the two given. The abdominal aorta too, could be ligatured by the same means. (Fig. 148, page 471.)

Crampton's operation.

Ligature of the internal iliac.

Ligature of the internal iliac.—Stevens, of Vera Cruz, in 1812, was the first to perform this operation in a case of gluteal aneurism, occurring in a negress, and the operation proved successful. Since his time, the operation has been repeated eleven times, and in six

with success. The incision and steps of the operation are the same as for the common iliac. Stevens, however, cut down through the anterior abdominal walls, similar to Abernethy's operation for the external iliac. It should not, however, be performed for gluteal aneurisms unless rapidly increasing till other means of cure have been tried and failed, such as pressure upon the aorta or common iliac, or even galvano-puncture. Besides Holmes has clearly shown in his College lectures, that in cases of imperfect or ruptured sacs, either the operation of Anel or that in which the sac itself is opened should be practised. Gluteal aneurism.

In operating upon any of the iliac vessels it should be remembered that great variety exists as to their length. When the common iliac is long, its branches are short, and *vice versâ*.

Ligature of the Femoral Artery.

This vessel can be tied in any part of its course, and when the thigh is straight, a line drawn from the centre of Poupart's ligament to the centre of the popliteal space, will mark out its position with tolerable accuracy. When the thigh is abducted and rotated outwards, a line drawn from the same point above to the inner side of the inner condyle indicates the upper half of its course. In the upper third, it is tolerably superficial; in the middle and lower, it is covered by the sartorius muscle, which varies much in its width, and by the membrane forming the roof of Hunter's canal. At the present day, it is an exceptional act to ligature the vessel in Hunter's canal. For popliteal aneurism, the artery is generally ligatured in the middle third of its course, at the apex of Scarpa's triangle. For aneurism of the femoral itself, the common femoral may be tied below Poupart's ligament. Ligature of the femoral. Place of election.

The **Common Femoral** is usually about an inch and a half in length, it does not exceed one inch in one case in four; while in one in four it is between an inch and a half and two inches. (Nunn.) It is from these facts that surgeons have generally preferred to ligature the external iliac rather than the common femoral. The two Porters, however, as well as Macnamara, of Dublin, have adduced sufficient evidence to prove that success may attend the practice, giving thirteen cases between them, and eleven proving successful. On the other hand, Erichsen tells us that out of twelve cases on record, three only succeeded—having evidently overlooked the Dublin cases. He states also as his opinion that the operation "ought to be banished from surgery." But with that I cannot agree, after a careful perusal of the Dublin cases in the 'Dublin Quart. Journ.,' 1860, and 'Brit. Med. Journ.,' Oct., 1867. Operation on the common femoral.

The operation, moreover, is not difficult; the vessel being readily exposed by a vertical, oblique, or transverse (Porter's) incision. The sheath of the artery is then to be opened without touching the vein,—indeed, the vein should never be exposed,—care being taken not to enclose the crural branch of the genito-crural nerve running down in front of the vessel, in the ligature.

The main arguments against the operation are founded on the uncertain length of the artery, the proximity of the ligature to large branches, and the liability to gangrene from the occlusion of the main nutrient arteries of the limb. On the other hand, there is the success of the operation, and the facility with which it can be performed. More experience, however, is required before the operation can be recommended, though it should not be dismissed without due consideration. Objections to the operation.

Ligature of the middle third of the femoral.

Statistics of the operation.

Ligature of the femoral artery in the middle third of its course is a capital operation, and, moreover, a successful one. Norris gives 46 fatal out of 188 operations for aneurism or one fourth of the cases collected from all sources, from John Hunter's first operation in 1785 down to 1848, and undertaken too under many different conditions. Syme informs us that he has had 23 successful cases consecutively, and at Guy's Hospital during fourteen years, the femoral artery was tied for aneurism 24 times, with only 1 death from pyæmia, and one failure, these cases including 6 in which pressure had been tried and failed. Pressure had been employed in 17, and in 11 with success. Mr. Holmes, in his lectures at the Royal College of Surgeons in 1874, moreover, gives some statistics of recent hospital practice, which possibly places the operation in even a better light, inasmuch as out of 77 cases of popliteal aneurism treated by ligature at once, the deaths were 11, or 14 per cent., and the failures 15, or 19 per cent.; while in 44 other cases in which the ligature was applied after the treatment by pressure had failed, 31 succeeded and 13 failed, or 29 per cent., the mortality in the latter class of cases, as might have been expected, being larger than in the former.

I may add, that of 124 cases of popliteal aneurism collected by Mr. Holmes, pressure succeeded in 66, and failed in 58. In 44 of the 58 cases the artery was tied, as seen above, 13 of these dying; and of the remaining 14, amputation was practised in 8, death occurred in 1, while in 4 there was no evidence of subsequent treatment.

The operation.

Description of the operation.

To tie the vessel, the limb of the patient should be slightly abducted and rotated outwards; the leg being partially flexed and the knee supported on a pillow. The line of the vessel should then be marked by the eye, and the point at which the ligature is to be applied determined, the lower part of Scarpa's triangle being the "point of selection." (Fig. 156.) An incision about three inches in length must then be made parallel to the vessel dividing the integument and superficial fascia down to the deep parts; the course of the superficial veins having previously been ascertained by making pressure upon the saphena vein where it joins the deep femoral, in order to avoid it. If the vein be in the way, the incision can be made by its side, but generally it is on the inner side of the wound. The deep fascia may then be divided, and the *inner* border of the main guide to the artery, the Sartorius muscle, looked for. This is readily recognisable by the course of its fibres *downwards* and *inwards*, and underneath this the sheath of the vessel is certain to be found. The muscle having then been gently separated from its attachments by means of the finger and held *outwards* with a retractor, the sheath will be exposed with the artery in front and vein behind, the long saphenous nerve generally and sometimes a nerve to the vastus internus, lying upon the vessel. The sheath should then be opened with caution and its inner side held tense, an opening being made sufficient to expose the vessel and admit the aneurism needle; moreover care should be taken to keep the end of the needle close to the artery, in order that the vein may not be injured or included in the ligature. The needle ought to be passed from within outwards. The ligature having been passed, the surgeon must satisfy himself that nothing but the artery is surrounded, and that the right vessel has been exposed; he may then tie it, readjust

the parts, and close the wound, covering the limb with cotton wool and raising it on a pillow. Should the vein be wounded by the needle, the artery must not be tied at the point corresponding to the wound but about an inch higher or lower, for "the thread would be left in the vein to act as a seton, and phlebitis could hardly fail to ensue, and would most likely prove fatal." (Holmes.) The wound in the vein should be closed by a fine ligature.

Method to be pursued when vein wounded.

A ligature may separate from the femoral artery in nine or ten, or not even for thirty days, a wide difference existing on this point. An analysis of cases decisively proving that no general rule can be laid down as to when its separation may be expected.

Ligature of the Popliteal Artery.

Ligature of popliteal.

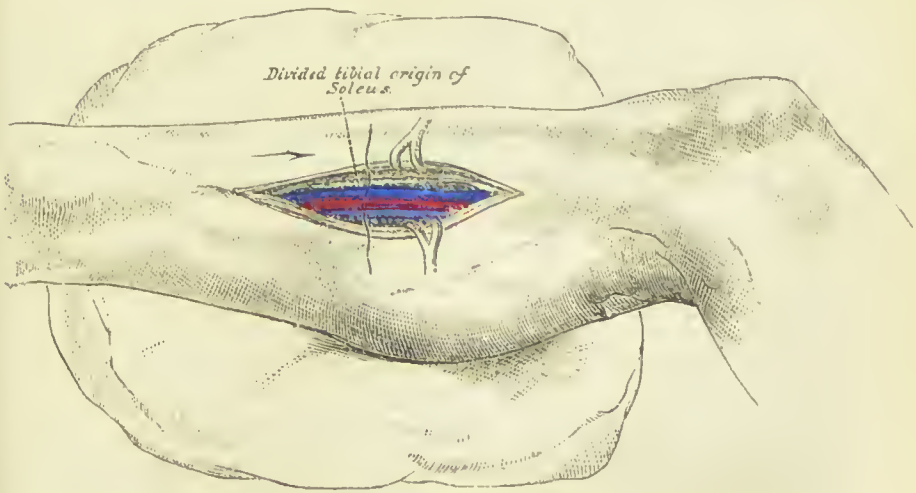
I hardly know under what circumstances the *popliteal artery* may require the application of a ligature, except for a wound; as for rupture of an artery, or for aneurism the operation is as inapplicable as it would be unsuccessful. Mr. Poland has pointed out how the posterior ligament of the knee-joint is frequently involved in the laceration of the vessel. Some years ago I was called upon to cut down upon a large needle that had perforated the popliteal space, and become lost in its tissues; all movements of the joint being impossible by the pricking pain of its presence. I discovered the foreign body lying obliquely across the popliteal artery with its point fixed in the posterior ligament of the knee-joint. The artery was exposed without difficulty by an incision made along the outer edge of the semi-membranous muscle, the leg being extended. The vein is more superficial than the artery and can always be found to its outer side above, the nerve is still more superficial, and above still further out, but it lies over the artery at the back of the knee and to its inner side where covered by gastrocnemius.

Ligature of the Posterior Tibial Artery.

Ligature of the posterior tibial. Guthrie's practice.

Guthrie brought the weight of his great authority to support the

Fig. 157.



Ligature of posterior tibial artery.

recognised practice of tying a wounded vessel at the wounded part,

even in the case of the deeply placed posterior tibial and peroneal arteries, and practically carried it out in a supposed wound of the latter vessel by making a free incision through the muscles of the calf of the leg down to the wounded artery. Arnott, also, acting on Guthrie's suggestion, tied the posterior tibial by this method, though neither the report of the case ('Med.-Chir. Trans.,' vol. xxix), nor Mr. Arnott's remarks, are encouraging in any way in favour of its repetition; indeed, modern surgeons have universally rejected the method in favour of that which has now been described.

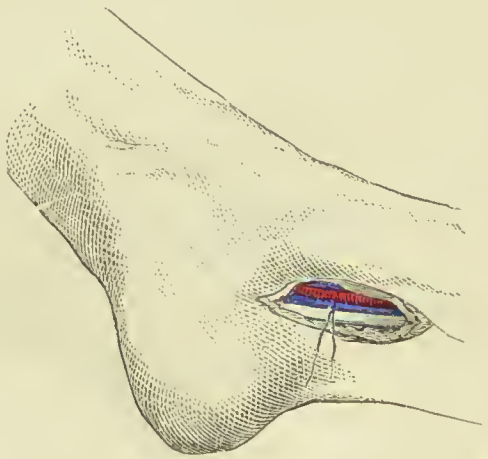
It must be premised that the vessel lies beneath the superficial layer of muscles forming the calf and beneath the deep fascia, the nerve being towards the inner side above, but to its outer side, in the greater part of its course. Its course too is indicated by a line drawn from the centre of the popliteal space to a point midway between the inner malleolus and the tendo Achillis.

Operation on the artery in the middle of the leg.

In order to tie the artery, the leg must be partially flexed upon the thigh and made to rest upon a pillow on its outer side, the heel being raised to relax the muscles. An incision about four inches in length should then be made about half an inch from the edge of the tibia and parallel with it, through the integument, down to the deep fascia, avoiding, if possible, any large superficial veins. The deep fascia can then be divided and the muscles exposed. The lower border of the tibial origin of the soleus muscle should then be looked for, and beneath it a director introduced; the tibial origin of this muscle should then be divided the whole extent of the wound. The glistening tendinous covering of the deep surface of the muscle is an excellent guide to the vessel, and should not be mistaken for the deep fascia which lies deeper, and beneath which is found the vessel. To search for the artery, the leg must be well flexed, the heel drawn up, and the muscles retracted. The ligature can then be passed in the most convenient way.

On the dead subject this operation is not difficult, and on the

Fig. 158.



Ligature of posterior tibial artery behind inner malleolus.

living, more particularly when performed with the aid of Esmarch's bandage, it can hardly be so "difficult, tedious, bloody, and dangerous" as Mr. Guthrie has described, and as is his own operation.

The operator should be careful, however, not to divide the tibial origin of the soleus too near the tibia, as in doing so he may penetrate too deep beneath the deep fascia, and thus lose his best guide, viz. the glistening tendinous tibial origin of the soleus.

To tie the artery at the *lower third of the leg behind the inner malleolus* is a simple operation. It lies with its venæ comites at the junction of the anterior with the middle third of the space between the malleolus and the heel, the nerve being behind. It can readily be exposed by a curved incision two inches long over the course of the vessel, dividing integument and *deep* fascia, which is thick from receiving many fibres from the internal lateral ligament. The relative position of the vessel can easily be seen in the drawing (Fig. 158.)

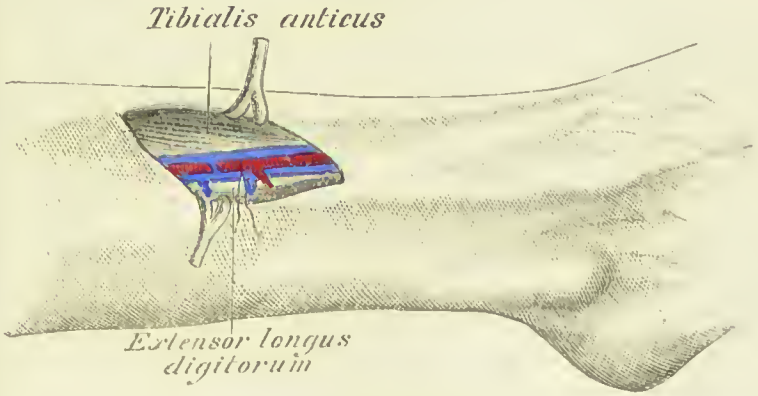
Operation on the artery behind the malleolus.

Ligature of the Anterior Tibial Artery.

Ligature of the anterior tibial.

This operation is far from simple, inasmuch as the vessel lies buried in the upper two thirds of its course between the muscles on the

Fig. 159.



Ligature of the anterior tibial artery.

interosseous membrane; its course is indicated by a line drawn from the inner side of the head of the fibula to the base of the great toe. The surgical guide to the vessel is the tibialis anticus muscle, which *lies to its inner side* throughout its course.

To reach the vessel in the upper two thirds of its extent it is important to expose the intermuscular space separating this tibial muscle from the extensors communis digitorum and proprius pollicis, and the best way to accomplish this is to make an oblique incision four inches long commencing at the outer edge of the tibia and directed downwards and outwards towards the external malleolus, dividing the integument and superficial fascia. The deep fascia will then be exposed, and the first white line external to the tibia will be found to mark the intermuscular space outside the tibialis anticus muscle in which the anterior tibial artery is to be found. The fascia over this line may then be opened, and the muscles separated, the foot being well flexed to facilitate this measure. The anterior tibial nerve will then come into view, and beneath it the artery will be found. The ligature may be passed as best can be done.

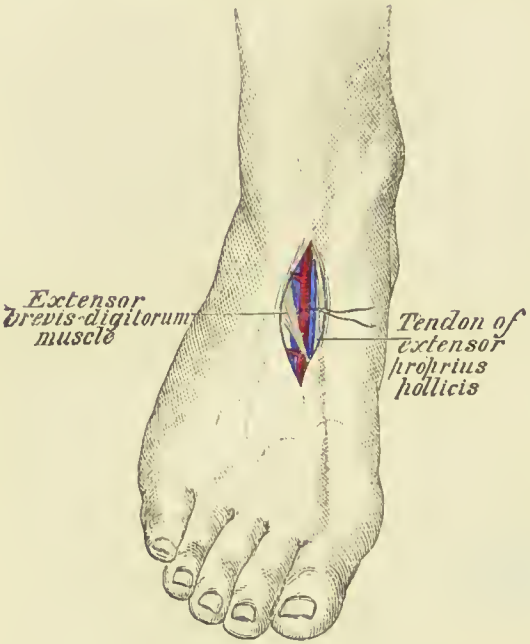
Mode of reaching the vessel.

Ligature of Dorsal Arteries of the Foot.

Ligature of the dorsalis pedis artery.

The dorsalis pedis artery should be ligatured to the outer side of the extensor proprius pollicis muscle, by the side of which it lies. The vessel can readily be exposed by an incision made along its course, the integument and *deep* fascia being divided. (Fig. 160.) It is crossed at its lower part by the tendon of the extensor brevis digitorum muscle, and the nerve lies outside the vessel, while venæ comites attend the artery. The tendon of the last-named muscle is an infallible guide to the artery, as it crosses it, whilst the tendon of the extensor proprius pollicis muscle is the guide to the incision. The surface line of this vessel extends from the middle of the joint of the ankle to the base of the first metatarsal space.

Fig. 160.



Ligature of dorsalis pedis artery.

CHAPTER XI.

INJURIES AND DISEASES OF THE VEINS.

Wounds of veins.

The blood from a wounded vein is black, flows in a steady stream, and never jets out as from an artery. When mixed with arterial blood, as occurs when both artery and vein are punctured, it appears as a dark band, streaming through a red, or *vice versâ*; the relative thickness of black or red band indicating the extent of the wound in the artery and vein. Pressure on the distal side of a wounded vein controls bleeding, whilst pressure on the cardiac side increases it.

Mode of union.

Wounds of veins unite as do wounds of arteries, the reparative process being alike in both. After a clean incision into a vein repair may be so perfect in a few days as to leave no trace of injury behind. The lips of a wound in a vein readily unite—as after venesection, when kept together by gentle pressure, or the application of a ligature.

Complete division.

A completely divided vein contracts, though somewhat less than an artery; it also *retracts* into its sheath, and the natural arrest of hæmorrhage is helped by these actions, together with the coagulation

of the blood in the vein and around its orifice. But these processes are slow in their action, very feeble, and practically insufficient. Fortunately, however, hæmorrhage from a divided vein is easily arrested by well-adjusted pressure and by elevation of the limb. After amputations, if venous bleeding persist on the removal of the tourniquet, and, should the means just indicated have failed, the bleeding vein may be acupressed, ligatured, or, what is better, twisted, to stop it. When deep veins of large size are divided and cannot be treated, a fatal result rapidly ensues.

Partial division.

A partially divided vein often gives much trouble, although not when *superficial*, because the elevation of the limb, and a compress carefully strapped or bandaged over the wounded part, are generally sufficient to check the bleeding, and in three or four days, repair may fairly be expected.

Wounds of deep veins.

Wounds of deep veins, however, are of grave importance, for they may be so situated that pressure cannot be applied, or, bleeding may be so profuse as to cause speedy death; and further, unhealthy inflammation of the vein may follow with all its dangers.

Treatment. Pressure.

In wounds of any of the veins of the extremities well-applied pressure is, as a rule, sufficient to arrest bleeding, and give time for repair, although when the trunk of the femoral vein is wounded in operation, as in ligature of the femoral artery, the opening in the vein may be taken up, when it is in view, with a pair of forceps and tied with a fine silk ligature. The same should be done to a punctured wound of the internal jugular, or any large vein. When this practice cannot be carried out the whole vein must be tied. Wounded veins, indeed, may be treated on the same principles as wounded arteries. When pressure is enough to arrest hæmorrhage from a vein, however large, the ligature is not required; but when it fails, or is inapplicable, the ligature may be fearlessly employed. The dread of setting up phlebitis by ligaturing veins is based on prejudice and not on experience; it is doubtless due to the influence of authorities who have pronounced against it. It cannot, however, be disputed that phlebitis occasionally follows the surgical treatment of veins. When it occurs the affection is serious, and takes place only in the enfeebled and cachectic.

Ligature.

Wounds of internal jugular and subclavian veins.

Wounds of the *internal jugular and subclavian veins* are as fatal, and probably more so, as wounds of the carotid or subclavian arteries. When the internal jugular is wounded near the base of the skull life is speedily destroyed, and, when near its cardiac end, to the danger of hæmorrhage is added that of the introduction of air into the heart. When the internal jugular is divided *above* the clavicle, the orifice remains open; the walls not collapsing as they would at a greater distance, owing to their connections with the deep cervical fascia; reflux bleeding consequently takes place from the cardiac end, and, during some violent inspiratory act, air may be drawn into the circulation and into the heart, causing death. Hence great care is always required in operating about the root of the neck to avoid large veins, and to compress or ligature them when wounded.

When death transpires from primary hæmorrhage from the internal jugular it is generally within an hour. I recorded in the 'Trans. of Path. Soc.' in 1857 such a case which occurred in the practice of Mr. Birkett, a second was recorded by Mr. Henry Gray in 'Holmes' Surgery,' and a third by Mr. Samuel Cooper in his 'First Lines of Surgery.'

When death does not supervene from either of these two causes yet it may occur from secondary hæmorrhage or from pyæmia.

A vertical incision into the internal jugular vein is not necessarily attended with a fatal hæmorrhage. When bleeding occurs it will be recurrent. This was well illustrated in a case recorded by Mr. Woodman, of Exeter ('Brit. Med. Jour.,' 1873), in which the internal jugular vein was ligatured with a successful result.

Coagulation in veins.

Coagulation in veins. Adhesive phlebitis.

Adhesive phlebitis.—When a vein was found by the older surgeons obstructed by a fibrinous clot, the suspicion of phlebitis was excited, and, when this clot contained in its centre a "puriform" fluid, the evidence of inflammatory action was considered to be strong. When the clot was more or less adherent to the inner membrane of the vein, and this membrane presented a pink appearance, the evidence was thought to be complete. At the present day, however, none of these phenomena are accepted as true indications of an inflamed vein; as it is known that blood coagulates spontaneously in a wounded, lacerated, or bruised vein from prolonged pressure upon its walls, or inflammatory changes in the parts around, and that even in ill-nourished and cachectic subjects, there is a remarkable tendency for the fibrin of the blood to become deposited upon the serous lining of the veins, either idiopathically from some altered condition of the blood, or on the slightest injury, without the existence of inflammatory action.

Indications.

Evidences of an inflamed vein difficult to determine.

Supposed pus in clot.

The supposed pus found in the centre of the fibrinous mass is known to be made up of the white blood-corpuscles present in all coagula, while the pinkish tint upon the serous lining of the vein is due to the mere imbibition of colouring matter from the blood, and not to inflammatory injection.

Tendency of clot to increase rapidly.

A clot once formed in a vein rapidly increases, the stream of blood as it flows over it depositing fresh layers, until the whole calibre of the vein is obstructed; when the process is slow, regular layers of fibrin may be seen in section, but when rapid the clotting is irregular. At the extremities of the clot, also, like accretions are deposited; the coagula increase more or less rapidly in all directions and into all branches, till complete obstruction, or THROMBOSIS, takes place. This clotting of blood in the vein becomes arrested only by the blood stream of a junction trunk. These coagula can readily be removed by washing, and when removed, the lining membrane of the vein will generally be found natural and the valves visible. The coat of the veins at times may appear thickened from contraction, but Mr. Callender has shown, that this is not real but only an apparent condition, the coats of the veins readily yielding to pressure under water. In the process of cure sometimes the clot will contract towards one side of the vein, thus allowing the blood to pass and the circulation to become re-established. In rarer cases the blood "may drill for itself a passage through the centre of the clot." Ordinarily, however, a different result takes place, the vein becomes permanently obliterated, the clot and vein ultimately contracting so as to form a firm and shrunken cord. In rare cases, the clot may subsequently organize. Authors have described these as instances of *adhesive phlebitis*. In feeble and cachectic subjects, however, these curative changes cannot take place. The

Thrombosis.

Thickened coats not real.

Clots may not obstruct entirely.

clot instead of organizing will soften and disintegrate, giving place to blood-stained puriform fluid, that may be carried into the pulmonary circulation and, causing a lobular pneumonia such as is found in pyæmia from embolism of the pulmonary artery. This was well illustrated in the following case, extracted from the catalogue of the Guy's Museum, No. 1521[55]. Jugular vein exhibiting a wound occupying about half its circumference, and situated about half an inch above the subclavian, the neighbouring branches showing the effects of phlebitis.—James F—, æt. 30, under Mr. Birkett. He received a stab with a knife in the left side of the neck which wounded the jugular vein; much hæmorrhage followed and continued for some days, when symptoms of phlebitis set in, and he died of pneumonia twenty days after the accident. The vein was found to be wounded as seen in the preparation, its coats infiltrated with lymph, and its interior filled with fibrin. The lungs were filled with abscesses.

Clot may soften and disintegrate and escape into circulation.

Example.

Results such as these, however, do not occur under all circumstances, but only in the feeble and cachectic, for "the clot when softened is usually shut off in an upward and downward direction by newly added coagula. The softening begins in the coagula last formed, and not, as Virchow states, in those first deposited, for in the advance of the malady the patient's health fails, and the fibrin becomes more and more prone to disintegrate and soften into a puriform fluid." (Callender.) The clot softens also in the centre and not at its periphery, and such cases have been described as examples of *suppurative phlebitis*.

Symptoms.—The most prominent symptom of an obstructed vein is œdema of the parts below the obstruction, some fulness of the superficial veins, local pain and tenderness; constitutional disturbance of variable degrees of severity generally preceding. When superficial veins are involved the symptoms may be chiefly local, but in the case of deep veins, constitutional disturbance is certain sure to accompany local action. Among the superficial veins the saphena of the leg and thigh is most commonly affected, and is often a sequela of a varicose condition. Under these circumstances, the tortuous, dilated, indurated vein becomes a marked object, set as it were in a frame of hardened inflamed skin and cellular tissue. The parts themselves will, to a certainty be painful, and the pain and tenderness probably extend up the thigh as far as the groin. Among the deep veins, the common femoral or iliac is more frequently involved than any other, and what is known by a "white leg" is due to this affection; it being an œdema of the leg from an obstruction to the femoral or iliac vein, and is usually the first symptom that attracts attention. Local pain and tenderness, with more or less constitutional disturbance, always, however, accompany the œdema. In some cases the phlebitis is of a very mild character, and then a good result may be anticipated; but in others it is very severe, and in such suppurative changes will probably take place.

Symptoms of an obstructed vein.

Superficial veins.

It sometimes happens that a limb becomes much enlarged and solid in the deeper but not in the superficial parts, that is, no œdema of the cellular tissue beneath the skin will be present, although the superficial veins may be turgid. The absence of this symptom, however, must not mislead; as it simply indicates that the superficial circulation is

Deep veins.

efficiently carried on, and that no stagnation exists sufficient to allow of passive serous exudation.

Progress and result.

When these cases proceed favorably the swelling will gradually subside, as will also every other symptom, the vein either recovering its normal condition, or the blood finding its way through other channels. When they go on unfavorably, suppuration will take place, and if the deep parts are involved, the case assumes a very serious aspect; as a local or a diffused abscess may result (the latter condition being the more common) and then blood poisoning too frequently ensues with its usual consequences.

Treatment.

TREATMENT.—The two great indications for treatment in these cases are (1) *to favour the venous circulation of the part, and* (2) *to improve the general condition of the patient.*

Favour the circulation of the part.

The first can be attained by elevation of the limb, the foot being raised higher than the hip, and, by the application of warmth to the part in the shape of fomentatious or cotton wool.

Attend to general health.

The second can be carried out by the administration of a simple nutritious diet, tonics, such as quinine, bark or iron, and stimulants carefully adjusted to the wants of the individual case.

Pain must be allayed by both local and general means, as poppy fomentations, and the internal use of opium, morphia, or chloral.

Leeching should never be resorted to, nor mercury in any of its forms, as the practice was based on a mistaken pathology, and therefore should be disearded.

When suppuration occurs.

When suppuration appears it must be dealt with on ordinary principles, as it is wise, as a rule, to evacuate it as soon as it has declared itself.

Gouty Phlebitis.

Gouty phlebitis.

Subjects who are gouty from hereditary or acquired causes are likewise liable to *adhesive phlebitis.* Sir J. Paget has well described the affection in his 'Clinical Lectures,' 1875; and Mr. Gay has also written ably upon it ('Lancet,' May 19th, 1877):—"In such cases the phlebitis may have no intrinsic characters by which to distinguish it, yet not rarely it has peculiar marks, especially in its symmetry, apparent metastases, and frequent recurrences."

Like other forms of phlebitis is it more common in the lower than in the upper extremities, yet it may be found anywhere. It affects, however, the superficial rather than the deep veins, and often occurs in patches, affecting on one day (for example) a short piece of the saphenous vein, and, the next another piece of the same, some other distant vein, or, a corresponding piece of the opposite vein.

The inflamed portions of vein usually feel hard, and are painful to the touch. The soft parts covering the vein become slightly thickened, and often have a dusky reddish tint. When the deep veins are involved, œdema appears with the well-recognised results of venous obstruction, "the limb becomes big, clumsy, featureless, heavy, and stiff; its skin is cool and may be pale, but more often it has a partial slight livid tint, which might be discerned by comparison with the other limb, and has mottlings from small cutaneous veins visibly distended." The limb thus enlarged feels œdematous throughout; but

firm and tight-skinned, not yielding easily to pressure, and not pitting very deeply.

By almost this state alone the disease can sometimes be recognised.

The constitutional symptoms associated with this local affection vary from some slight febrile condition, to those met with in acute gout. Complete recovery may take place in this, as in other forms of phlebitis—the veins becoming pervious in some cases and obstructed in others; the limb reassuming its healthy condition or becoming permanently enlarged, cumbrous, and heavy. The risks of embolism are also the same.

TREATMENT.—Nothing special can be recommended, as the so-called gout remedies do not appear to have much influence on the local disease. Rest, elevation of the limb, lead lotion to the inflamed vein when superficial, and fomentations when deep, are the chief points to be attended to in the local treatment; as well as a lower diet, abstention from stimulants, and saline drinks in general. When feebleness exists the liquor ammonia in doses of five to ten drops with bark is an excellent remedy, but at others, quinine is called for.

Diffuse or suppurative phlebitis.

There is, however, another form of phlebitis that must be mentioned, and which is by far the most serious, viz., the *unhealthy diffuse or suppurative phlebitis*. It is an affection of the cellular tissue around the veins, these veins themselves being secondarily involved. It is a species of erysipelatous inflammation of a low type, and it is only found in the feeble and cachectic. It comes after a severe injury to, or operation on, bone, or otherwise; after a slight contusion or a severe wound; it may supervene on the puncture, division, or ligature of a vein, or, chronic suppurative disease more particularly of the bones of the cranium. It occurs also in the puerperal state. Depending upon a vitiated condition of the blood, "we are able to appreciate how it is that the many different forms of phlebitis may follow various dissimilar injuries, and reconcile the frequency of their occurrence after operations involving the venous system. The dangers are not to be looked for when the general condition of the system of the individual is good, and when the walls of the vessels are in a healthy state, but they may be anticipated in enfeebled and broken-down constitutions, more particularly when the coats of the vessels are abnormally changed. Upon such a class of persons operative procedure should, therefore, if possible, be avoided." (Dr. S. W. Gross, 1867.)

Depends on vitiated blood.

Local symptoms.

The disease shows itself as a purulent infiltration of the cellular tissue surrounding the vein, with a thickening and softening of the coats of the vein itself. As the disease progresses, abscesses form around the vein, whilst the circulation through it is arrested by the formation of coagula in one spot, and a sloughing abscess in another. In superficial veins, such as in the leg, all these changes can be well observed, but in the deep they are difficult to diagnose. In the superficial, the external signs of inflammation are well marked, local redness and brawniness of skin around a dilated, thickened, and tortuous vein being the chief symptoms. As the disease progresses, local abscesses appear in the vein itself, which yield blood and pus on being opened, these contents being, doubtless, broken-down coagula.

Constitutional symptoms.

The constitutional symptoms vary with the extent and severity of the disease; marked depression of the general powers always being present, while rigors not only usher in the attack, but attend its

progress; each one probably indicating some suppurative change. Local pain and sleeplessness are common accompaniments, and in cases that cease to be local and have an infective tendency those known as typhoid symptoms occur. When blood poisoning or pyæmia appears, the symptoms are such as have been described in an early chapter.

On the Presence of Air in Veins.

On air in veins.

That air may find its way to the heart through an open vein and cause sudden death, is a clinical fact with which all surgeons should be familiar, also that it generally occurs during the removal of tumours about the neck and axilla, amputations at the shoulder-joint, and operations or wounds involving the cervical or other veins. It has likewise occurred in uterine surgery from the injection of air or gas, &c. Two thirds of the patients affected die from the accident, half within a few minutes, others living hours or a few days. The accident is favoured by a thickened state of the vein, and is generally indicated during the progress of an operation by a sudden gurgling, hissing, or bubbling sound in the wound, associated with venous bleeding, sudden faintness, and insensibility of the patient, or convulsions, probably terminating in death. When this result does not at once transpire there will be laboured and irregular respiration, tumultuous action of the heart and feeble pulse, the lividity of the patient gradually disappearing; the heart then regaining its natural action, and the patient recovering. Bubbles of air may at times be seen in the wound. In some cases, the patient will give a sudden cry with the first onset of the symptoms.

Mortality.

Symptoms.

After death, evidence of the admixture of air with the blood has been found such as bubbles in the vessels of the brain, or in the large venous trunks and arteries. In some cases air has been found in the right cavities of the heart. Where a suspicion of this cause of death exists, the heart and large vessels should be opened under water to make manifest the escape of air-bubbles—one single bubble indicating air in the heart, and many, air in the vessels. Experiments on animals by Erichsen, and by a French commission, tend to confirm this observation.

Treatment of air in veins.

Treatment.—How to deal with these cases has now to be considered, and, without doubt preventive are more important than curative measures. In dealing with large veins, or, indeed, any veins near their cardiac ends, the surgeon should be careful to apply pressure and to maintain it during the operation; while in some instances it is more expedient to ligature before dividing or twisting them. When the bubbling sound has been heard, pressure must at once be applied to the spot where the bubbles appear. When a large vein has been wounded by accident and its division is not required, the opening must be taken up by forceps and carefully closed with a fine silk ligature. The surgeon should always avoid large veins when it is possible.

Artificial respiration.

When air has been admitted into the heart and its action interfered with, the surgeon's aim should be to keep up its action and help the respiratory act by artificial means such as by cold water on the face and thorax, stimulants, as ammonia to the nostril, &c. Amussat ascribed recovery in one of his cases to pressure upon the chest, leaving the opening in the vein free, to allow of the escape of the ad-

mitted air, but, in adopting this practice, care must be observed to close the orifice of the vein in the inspiratory act. Brandy and diffusible stimulants should also be freely given to sustain and stimulate the vital organs.[1] Stimulants.

Hypertrophy and atrophy of veins occur in precisely similar circumstances as hypertrophy and atrophy of other structures. Thus, where increase of function of a part exists, or increased growth, the veins will elongate, dilate, and thicken. When decrease of function or disease of a part takes place, the veins waste or become atrophied with other structures. Hence, after amputation of the thigh, the femoral vein becomes as small as the anterior tibial; and, in Mr. Cock's case of arterial varix related in page 460, the vein above the varix withered to a mere cord. On the other hand, in the same case of arterial varix, the popliteal vein below the varix, when taking on the action of an artery, became much enlarged and thickened, in fact hypertrophied, simply on account of the increase of work it had to perform under its new condition; and the superficial cutaneous veins through which the whole of the returning blood must have passed became enormously enlarged. An equally good instance of hypertrophy of veins can be seen when any obstruction occurs to one of the cavæ or any large venous trunk, the venous circulation making its way through other channels, which consequently enlarge. Thus in Fig. 161 the skin veins of the abdomen and chest are seen to be enormously distended and hypertrophied to carry on the circulation from the lower part of the body to the heart; the lower vena cava having been completely obstructed from cancerous disease. The woman, æt. 47, a patient of Sir W. W. Gull, had no œdema of the lower extremities all through the case, thus proving the perfection of the compensatory venous collateral circulation, and probably indicating the gradual progress of the obstruction. Hypertrophy and atrophy of veins. Examples.

Fig. 161.



Collateral venous circulation taken from a woman æt. 47 (under the care of Sir W. W. Gull), in whom the inferior vena cava was completely obstructed from cancer. Guy's Hosp. Mus., drawing 44^{40}.

Calcareous and atheromatous diseases of the coats of veins may occur, but are rare affections when compared with their frequency in the arteries. In Guy's Museum 1538^{25}, there is a good specimen of ossified saphena vein, and at St. Thomas's Hospital and the College of Surgeons' Museums may be found examples of calcareous degeneration Atheromatous and calcareous diseases of veins.

[1] The reader may refer to an admirable paper on this subject, by Dr. J. S. Green, of Massachusetts, 'Amer. Med Journ.,' 1864.

of other veins. Gay has also described a dissection of a varix which "appears to have been occasioned by disease, originally atheromatous, followed by softening and ulceration of the inner and middle tunics of the vessel;" and Mr. Pick, of St. George's Hosp. ('Path. Trans.,' 1867), has given a somewhat similar example. How far, however, this atheromatous and calcareous degeneration is a distinct disease, or, an "after change in some local deposit of fibrin," is an open question.

Varix; varicose veins.

Varix; Varicose Disease of the Veins and Phlebolithes.

Definition.

The term "varicose vein" is unfortunate, as it is applied to any enlarged tortuous vessel, to such as have been already described as hypertrophied veins, and to others that are clearly due to some diseased action resulting in hypertrophy with dilatation. In the sequel the term will be confined to the latter condition.

Examples.

Varix is commonly an affection of the veins in the lower extremities, and mainly, of the branches of the saphena vein. When it involves the submucous vein of the rectum it is called a hæmorrhoid, and, when of the spermatic a varicocele. But "all the veins of the body may become varicose," said M. Briquet in 1824. In 1869, a child, æt. 4, was brought to me with a sacculated varix the size of a nut connected with a vein on the outer side of the right forearm: it had been coming on for a year and a half. Taking varix of the lower extremity as a type of the affection, it appears as a disease involving one or more, and in extreme cases all, of the branches of the saphena vein. In most instances it is confined to the larger trunks, and rarely spreads to the smaller tributaries.

Description of the disease.

In some, however, the affection appears to begin in the capillaries of the skin, and spread towards the larger trunks, and such cases are most common in women. They appear as "clusters of diseased venous radicles" (Gay), and rarely involve other than the smaller branches.

It must not be thought, however, that this affection is one of the superficial veins alone, for such is not the case. Boyer asserted this many years ago, and on his authority, the opinion has been accepted. Verneuil corrected the error, and, in the 'Gazette Hebdomadaire et Médicale,' 1855, showed, that varix is as often a disease of the deep veins as of the subcutaneous—the latter often indicating the existence of the former. He believed, moreover, that the intramuscular veins are sometimes affected without the subcutaneous. Hilton and more recently Callender has told us, that the varix of a subcutaneous vein is found wherever the intramuscular veins pass into the subcutaneous, mentioning that "the valves obstruct below, and the column of obstructed, slow-moving blood resists above." He has failed, however, to confirm Verneuil's remarks, that varix of the intramuscular branches is constant.

Gay's remarks.

Mr. Gay, an able author on varicose veins (1868), says, after many dissections, that "with superficial varicosity there are other serious lesions affecting both arteries and veins, deep and superficial, such as would lead to the conclusion that the general circulation has been subject to a very considerable and long-standing embarrassment, some incompetency of the arterial system or impediment to the venous, or both combined;" and these conclusions are probably correct.

The causes of varicose disease of the vein are obscure. Surgeons of the past regarded such affections as the invariable result of some obstruction to the venous circulation, such as prolonged standing, the presence of abdominal or pelvic tumours—pathological, fæcal, or fœtal; patients of a relaxed and feeble habit naturally suffering more than the robust; and, in a measure, doubtless their opinions were correct. Mr. Herapath, of Bristol, maintained that the cause of varix was the narrowing of the saphenous opening of the thigh, and cases are on record where its enlargement proved of value; facts however, are wanting to support this view. General testimony also admits that this disease is as common in the higher as in the lower ranks of life; and in women as in men; that it is as frequent on the right as the left side, and more frequently on both; that it is a disease of the young as much as of the middle-aged; that it is met with in the strong and healthy as well as in the feeble and cachectic; in fact, it is found under every condition of life and in every variety of subject. Some evidence exists that gout and hereditary predisposition are efficient causes, with local injuries and prolonged muscular exertion. Causes of varicose veins.

The symptoms vary according to the place of its origin. When it commences in the venous capillaries—its common seat in women—it appears as a fine capillary injection giving an arborescent appearance to the skin, with more or less congestion; and, as it extends, the larger venous trunks become involved, the main trunks being rarely affected. Symptoms.

When it originates in a large trunk, the varix may appear as a fusiform enlargement, or a simple dilatation of the whole length of the vein. In some there will be thinning of the venous coats, in others a thickening, whilst in a third class, one part will appear thin and another thick.

Again the affected vein becomes tortuous and knotted to an extreme degree, and it is far from unusual to find it the diameter of a finger (Fig. 162). The valves of the veins under these circumstances are clearly lost, not, however, from a yielding, due to backward pressure of the column, but from their action being rendered imperfect by the dilatation of the vein behind; the "valve cusps being unable to meet and close the canal shrink and atrophy."

Fig. 162.



Varicose veins. From wax model.

As the disease progresses the tissues around the affected vein become gradually absorbed; the skin is thinned and even the bone grooved; the skin indeed becoming so thin as even to rupture, and, a fatal hæmorrhage is far from being a rare result. At Guy's during the last few years several cases of this sort have taken place. Subcutaneous rupture of the vein may at times occur, of which I saw a severe instance in a man æt. 62, in 1858. More frequently, however, the soft parts around the diseased vein thicken or inflame. They thicken from a kind of passive exudation into the cellular tissue, the result of impeded venous circulation, and give rise to a slightly anasareous condition of the part, which in chronic cases becomes somewhat permanent, producing what Liston so well Progress and results.

May simulate elephas.

described as a "solid œdema." In extreme instances, this solid œdema is so marked as to give rise to appearances similar to the disease called "elephas," or Arabian elephantiasis.

May inflame.

On the other hand, it is a very common result for the cellular tissue around the vein to inflame, and probably the vein itself. The parts around the varix or tortuous vein become indurated, red, and painful. In healthy subjects this inflammation may end as an adhesive one (local adhesive phlebitis), and in the feeble as a suppurative; local or diffused abscesses subsequently showing themselves. When the powers of the patient are very low, or blood poisoning takes place, that terrible disease, unhealthy suppurative phlebitis, previously described, may ensue.

In the early period of the disease, an aching of the limbs on standing, or after exercise, may be the only symptom, a local pain occasionally indicating the seat. In a more advanced period, œdema around the ankle may be observed.

May simulate femoral hernia.

When the femoral vein, where the grand venous junction takes place at the saphenous opening becomes dilated, the swelling may, on a careless examination, be mistaken for a *femoral hernia*, for both will disappear on the patient assuming the recumbent posture, and reappear on his coughing. There is, however, this point of distinction, that while by local pressure on the crural ring a femoral hernia can be kept in its position, a femoral varix can be made to enlarge.

May give rise to thrombosis.

As a secondary result of varicose disease, the blood in the vein may coagulate giving rise to *thrombosis*, and this coagulum may break up causing a local abscess, or, it may wither and organize, causing occlusion of the vein, and, consequently a partial cure. There is reason also to believe, that this may dry up and become so altered as to form what

Phlebolithes.

are known as *phlebolithes*, as these have a laminated character, and, in Dr. Franklin's analysis are said to be composed of protein matter and phosphate of lime, with a little sulphate of potash and lime.

May be associated with eczema.

With varicose disease of the veins there is very frequently associated an eczematous condition of the leg, the eczema being apparently due to the feeble venous circulation of the part. If this eczema be neglected, a superficial ulceration of the skin may ensue, and if no attention be paid to this condition, the ulcer becomes chronic. But beyond this, no special form of ulcer can be said to exist as a result of

Varicose ulcer.

varicose veins, in fact, there are no "varicose ulcers." In practice every variety of ulcer is found associated with varicose disease, and the existence of the latter, doubtless renders the repair of the former somewhat more difficult. Thus it appears that chronic indolent sores associated with varicose diseases have been termed "varicose ulcers."

Treatment.

TREATMENT.—Varicose disease of the veins in its early stage is very amenable to treatment, but, later on, none are more obstinate; the patient being only relieved, and rarely cured. Happily, however, under common care it never threatens life.

In early stage local.

When the affection is first discovered, the local treatment must be directed to assist the venous circulation by the raised position of the limb, the patient being recumbent; friction, too, should be steadily applied upwards; all sitting, standing, or walking be strictly prohibited; and, when possible, this treatment should be persevered in for three or four weeks. When exercise is allowed, steady pressure by a well-applied

bandage from below upwards should be maintained, or an elastic stocking worn, and, in the course of time, the extent of which greatly varies, a cure may be effected and maintained.

During this time, the general treatment must not be neglected. Where the powers are feeble, tonics must be given, and of these, iron is the best; twenty drops of the tincture of the perchloride, with ten of the tincture of nux vomica being an excellent compound. General.

A generous diet must be given when indicated, and the reverse where the portal system has been overgorged by excess. Mild aperients are always of value under these circumstances, salines being preferable to the purgative extracts. The natural waters are of great value.

When rest cannot be given, well-applied pressure must be relied upon, the best forms being a pad of cotton wool over the part with a bandage of Dommett's or elastic tissue, applied from the toes upwards, or good strapping evenly applied. The patient must be impressed, however, with the necessity of assuming the horizontal position as much as he can; aiding the circulation by friction as already indicated, and by general treatment. The bandage should always be put on before the legs are moved off the bed, and removed only after the recumbent position is again resumed. Pressure.

In bad cases of local varix, the pressure may be more local and permanent; a pad of cotton wool well fixed on by strapping being very valuable. When the veins are inflamed, they must be treated on principles already laid down in the chapter on phlebitis.

If a vein burst, bleeding can be controlled by the application of a finger to the spot, and any further flow is prevented by the elevation of the limb. A pad carefully adjusted to the bleeding point and fixed by strapping applied like a bandage or by a roller, makes the patient safe. When vein bursts

Operations for Varicose Disease of the Veins.

It has been observed, that nature not unfrequently obliterates a varicose vein by means of a coagulum which subsequently contracts and even organizes, the clot and vein together forming an impervious cord. Acting on this knowledge, surgeons now endeavour to make use of nature's processes, and, by artificial means, to induce coagulation of the blood in some portion of the varicose vessel with the hope that it may contract; or, so to destroy some part of the vein itself as to compel the circulation to find another course. This is the so-called "radical cure"—but it is to be thought of only, as Mr. Gay so truly says, when the vein is hopelessly deteriorated, or so inflamed and painful as to threaten to burst; or, in cases in which all palliative and other treatment is inapplicable or has failed. Natural obliteration. Surgical attempts to procure obliteration.

Caustics were employed by Mayo for this purpose, and also by Brodie, Key, and others. They should be thus applied:—A small piece of Vienna paste (composed of four parts of potassa fusa and four of quicklime, made into a paste with spirits of wine prior to its application), or chloride of zinc paste of the size of a small pea, should be applied upon the vein—the surrounding skin being previously protected by a ring of plaster carefully adjusted; the paste should be fixed on and left, the object being to cause a slough through the tissues into the vein. This slough should not be large, but three, four, or more applications may be simultaneously made about an inch apart, in order Caustics.

to guarantee success. The caustic may be left for twelve or twenty-four hours and then removed, water dressings being afterwards applied to the part. During all this treatment, the patient must be kept in bed with the limb raised.

Sub-cutaneous division of vein. Excision.

Subcutaneous division of the vein was practised by Brodie, but after some experience, he came to the conclusion, that "it really appears it is not worth patients' while to submit to it."

Excision of a portion of the diseased vein has likewise been employed with some success. My colleague, Mr. Davies Colley, in 1874 reintroduced the practice ('Guy's Hosp. Rep.,' vol. xx, series iii), which has been followed by Mr. Howse and others. The operation consists in the exposure of the varix by a free incision and its removal after the application of a carbolised catgut ligature to the trunk of the diseased vein above and below. Mr. Marshall, also, in 1875, adopted a like practice ('Lancet,' June 23rd, 1875), taking away some inches of diseased vein with forceps and scissors, after having isolated the portion to be removed by means of pins passed under the vein above and below. I think the operation is beneficial when the varix is local and requires surgical interference.

Acupressure with sub-cutaneous division.

Another operation much favoured and practised is that of *acupressure*. It is performed by passing a pin beneath the vein, but not through it, as in Davat's plan, and obstructing the circulation through the vein by means of a twisted suture either of silk, india-rubber, or wire applied round the pin, or, by a piece of thin india rubber stretched across it on the pin, as suggested by Mr. Lee. Two or even six of these acupressure needles may be inserted about an inch or an inch and a-half apart, according to the extent of the disease. Mr. Lee employs also the subcutaneous division of the vein between the pins at the same time, and my own experience confirms the wisdom of this practice. Mr. Wood employs an elastic steel spring to keep up tension on the ligature till it cuts its way through the vein.

Acupressure with injection.

On several occasions, having obstructed the circulation through the vein as already described, I have injected the vein between the pins with perchloride of iron, one drop being generally sufficient to cause coagulation of the blood; in others, I have used a concentrated solution of tannin; and in all, a good result ensued. The syringe should be that used for hypodermic injections.

Withdrawal of pins.

The time for withdrawal of the pins varies according to the effect intended to be produced. When inserted to induce coagulation of the blood only and not inflammation, they may be withdrawn on the third or fourth day, and, in the practice suggested of acupressure and injection this plan should be followed. Sir W. Fergusson states, "they should be left until they have excited considerable swelling and slight ulceration, and in some instances, where the former is not very conspicuous, they may be permitted to separate by ulceration through both vein and skin. I recommend that the process of inflammation should be more implicitly relied upon than that of coagulation." He adds, moreover, that he has not met with any seriously unpleasant effects out of the numerous instances in which it has been employed.

Fergusson's operation.

It must be repeated, however, that these operations should be practised only in extreme cases and not where palliative treatment is applicable. When a vein threatens to burst, or has burst and endangers life, surgical treatment is justifiable.

Mr. Gay called attentiou (Lond. Med. Soc., Oct., 1871) to a elass of eases in which the superficial or eomplementary veins, as he calls them, are obliterated; and, as a result, the return of the venous blood is earried on entirely by the deep veins. These eonsequently beeome diseased, the eireulatiou through them grows feeble, and degeueration of the tissues ensues, associated with deep-seated solid œdema of the limb, uot subeutaneous œdema, which belongs to obstruction only in the subeutaneous veins. For this disorder exereise, warm applieations, tonies, &e., are required; but bandages and rest do harm. Gay on obliteration of the deep-seated veins.

Venesection.

At the preseut time this operation is very rare indeed, and at Guy's Hospital it is as rare as, if not more so than, amputation. Forty years ago it was one of the most common, and there seems some reason to believe that it will soon be praetised again with greater frequeney, especially when we find Sir James Paget asserting "that we undoubtedly over-value the blood, and estimate too cautiously the loss of it;" that "the loss of blood up to fainting and in some cases I remember, with those epileptiform convulsions that eome with the loss of blood, is absolutely harmless," that is, when performed upon a large series of healthy persons, as was the custom in his student's days. ('Lanect,' Aug. 15th, 1874.) On venesection.

Fig. 163.



Venesection.—From Heath.

It is uot a difficult operation, but requires nieety and eare. It is usually performed at the bend of the elbow. The first thing the surgeon has to do is, to render the veius prominent by arresting the eireulation through them by means of a piece of broad tape or narrow bandage earried twiee round the arm a few inehes above the elbow, and tied in a bow, but not tight enough to stop pulsation in the arteries (Fig. 163). He then selects the vein, the largest being the best. Where the outer vein or median eephalie is of good size, it should be ehosen, as the inner or median basilic lies immediately over the braehial artery; either, however, may be seleeted, care being observed not to go *through* the vein. He should also assure him- Mode of operating.

self that no malposition of the artery exists, as many cases are on record where a superficial artery has been opened for a vein.

Fig. 164.



After venesection.—From Heath.

The vessel then having been selected, the surgeon should stand in front of the extended arm and hold it with his left hand, the thumb being fixed on the vein below the spot which is to be opened. With his right hand, an oblique incision, not a puncture, should be made through the skin into the vein, describing with the lancet a semicircular movement. The bleeding basin having been brought close to the arm, the surgeon's left thumb may be removed, and the stream of blood allowed to flow. If this be feeble, the patient may be asked to grasp a stick and put the muscles of the forearm well into action.

Mode of closing wound.

The required amount of blood having been withdrawn, the tape can be removed, the left thumb of the operator being applied to the wound, and the parts cleansed. A pad of lint is then to be placed over the incision, its edges kept well in contact, the thumb being slipped downwards to allow of the adjustment of the pad, which is to be fixed by a figure-of-8 bandage (Fig. 164). The arm should then be slightly bent, care being taken that the pad does not slip during this process.

On the second or third day, the pad may be removed, the wound having probably healed by that time.

Operation on the external jugular.

Opening the external jugular vein is sometimes called for, particularly when venesection is required in a child, and that part of the vein where it passes over the sterno-mastoid muscle should be selected. The vein can be steadied and rendered prominent by the left thumb of the surgeon applied at the root of the neck above the clavicle, or this may be done by means of a pad. It then is to be opened with the lancet by an incision made in the course of the sterno-mastoid muscle, and consequently across the platysma. Blood will then flow freely; and when enough has been taken the wound should be closed by means of a pad carefully adjusted. The thumb, which hitherto has been acting as a compress, may then be removed. The pad should be fixed by good strapping.

Avoid causing a thrombus.

In both these operations of venesection, if the wound in the skin be made smaller than that in the vein, or the position of the arm be changed, a blood tumour or thrombus may form from the escape of blood beneath the integument; and if this interferes with the flow of blood, instead of reintroducing the lancet, the best practice is to

untie the arm aud apply a pad to the wound, opeuiug a vein in the other arm.

Iu fat subjects there is occasionally some difficulty in findiug a vein. Friction of the surface of the forearm will at times help the surgeon, or, the applicatiou of a hot flannel round the arm, which should be made to hang down by the side of the body. When these means fail and venesection is imperative, a veiu of the foot may be opened.

Avoid air entering the vein.

In opeuing the jugular vein, great care must be taken uot to admit air into it by the removal of the thumb during the operation and until the pad has been adjusted, otherwise life may be endangered.

Gross, Dr. S. W., 'American Journ. of Med. Science,' 1867 and 1871.—*Callender*, 'Holmes's System of Surgery,' 2nd ed., 1870.—*Travers*, 'Surgical Essays,' 1818.—*Langenbeck*, of Berlin, 'Archiv fur Klinische Chir.,' 1860.—*Arnott*, 'Med.-Chir. Trans.,' vol. xv, 1829.—*Lee, Henry*, 'Disease of Veins,' 1866.—*Greene, James S.*, Dorchester, Mass., 'American Journ. of Med. Science,' 1864.—*Gay*, 'Varicose Diseases of Leg,' 1868.

THE SURGERY OF THE DIGESTIVE ORGANS.

CHAPTER XII.

AFFECTIONS OF THE LIPS, MOUTH, TONGUE, PALATE, AND TONSIL.

Wounds of the Lip.

Wounds of the lip.

Under all circumstances these wounds should be well cleansed and all foreign bodies removed. They should always be brought together by sutures, which ought, if any gaping exists, to be deeply inserted, as less deformity is likely to follow this practice than when the parts are left to granulate. Superficial wounds in the inside from the teeth may be left to granulate. When much bleeding exists the surgeon should examine the part with care, as Erichsen adduces a case in which so much blood was lost from the coronary artery, swallowed, and brought up again by vomiting, as to lead to the suspicion of some internal injury. Sutures in the lip are almost always removable on the second or third day. Plaster, as a rule, is uot required.

Congenital Fissures of the Lips

Fissures of lips.

occur more frequently as harelip than in any other form. Sir W. Fergusson has, however, quoted three cases in his 'Practical Surgery,' in which the fissure extended from the angle of the mouth, iu one case to the malar boue, in the secoud towards the angle of the jaw, and in the third to the base of the lower jaw. The treatmeut of these should be the same as for harelip.

Harelip.

Harelip.

How occurring.

This congenital deformity is due to a want of union between the natural centres of development of the upper lip. Thus the upper lip is made up of a central and two lateral portions, the central being connected with the intermaxillary bones, and the lateral, with the superior maxillary (Fig. 165). A want of union between the central and lateral piece on one side gives rise to simple harelip; a want of union between the central and lateral pieces to double harelip.

Fig. 165.



Showing the development of the intermaxillary and maxillary bones.—From Fergusson.

When the fissure is central—a very rare condition — the intermaxillary bones are either absent or divided. A specimen of the former exists in the museum of the Royal College of Surgeons, London, and a drawing of a like case taken from a patient of my colleague, Mr. Howse, is seen in Fig. 166. These fissures may be partial or complete, and may involve the skin alone as also the bone, and the latter in variable degrees.

I have seen in the lip of an adult (Fig. 167) a congenital cicatrix on the left side of the upper lip with a slight elevation of its mucous margin, said to be the very earliest indication of a harelip, and the child of this woman had a complete fissure. In more complicated cases, the cleft will extend through the alveolar process in a line corresponding with the labial fissure; in others it will involve the hard palate; while in a still worse class both hard and soft palate will be fissured.

Fig. 166.



Central fissure of lip, with deficiency of intermaxillary bones. Mr. Howse's case.

May be double.

In a small percentage of the cases—about a tenth—the harelip is double. In these, it is not uncommon to find a double fissure extending through the palate; the two superior maxillæ with the skin having failed to unite with the intermaxillary bones. Under these circumstances, the intermaxillary bones will often project, covered with a small flap of skin, and at times even stand out from the tip of the nose. In a rare case (illustrated in Fig. 171), the fissure involved the lip and intermaxillary bones alone, the maxillæ being complete.

Fig. 167. Fig. 168 Fig. 169.



Drawings illustrating the different degrees of single harelip.

These points are well illustrated in the annexed drawings which have been taken from patients to show the different degrees of the deformity.

This affection is more frequent on the left than on the right side of the mouth, and is more common in males than females, while in

Fig. 170.



Fig. 171.



Double harelip.

the more complicated this disproportion becomes more striking. Thus, in an analysis of cases to be found in my 'Lettsomian Lectures on the Surgical Diseases of Children,' 1863, four fifths of the bad cases were in boys, those of double harelip almost always being found in the male sex.

Treatment. Time for operation.

Treatment.—When ought a child with harelip to be operated upon? Sir W. Fergusson says, "I am of opinion that the earlier the operation is performed the better—assuredly before teething;" and the majority of surgeons would support this opinion. Judging from my own experience I am not disposed to coincide altogether with this opinion, for in my analysis of cases at Guy's Hospital, a larger number of failures followed the operation when performed during the first few weeks of life than after the third month. In healthy infants, it is probable that success may attend the operation whenever undertaken; but in the more feeble it is equally probable that success will be more certain at a later than at a very early period. Under these circumstances I always advise the operation to be postponed until after the third month; that is, when no necessity exists to hurry on the operation such as inability to take food, &c. On account of this last-named condition, I have operated with complete success on the fifth day.

How to hold the patient.

The position of the patient is important. If an infant, the whole body and arms should be bound round with a good towel, and the head fixed by the hands of an assistant placed on either side. The child should be firmly held in a nurse's lap, in the sitting posture (Fig. 172).

Fig. 172.



If an older child, the semi-recumbent position should be chosen with the head raised on a pillow and fixed as directed above. Under these circumstances chloroform should always be administered. When given to an infant, the head may be laid on the surgeon's knees, the body on the nurse's.

The operator may sit or stand behind the patient when the recumbent position is selected, or, at one side, if the patient be sitting.

Chloroform.

The operation.—Anæsthetics may be given without fear in such cases, although in uncomplicated examples the operation is so expeditiously performed as not to render it essential. I operate as frequently without as with it.

Objects.

The surgeon has two main objects in view in the operation, viz. to pare the edges of the fissure, and to adapt them, so as to render the deformity as slight as possible. But before this an important preliminary step demands attention, on which the success of the case materially rests, and that is, the free separation of both sides of the lip from the alveoli, and, when the nostril is widely expanded, the free separation of the ala nasi from the bone; the object of this step being to allow the soft parts to move freely over the bones and to be brought the more readily into apposition. Some save the true frænum and divide all other adhesions; but from my experience, I see no necessity for this practice. To pare the edges of the cleft, the knife should be employed; such an instrument making a cleaner section than scissors, and this cleanness of the incision is a point of importance. With respect to the form of incision, numbers have been devised, but most surgeons fall back upon the old-fashioned straight one, commencing at the apex of the cleft and ending at its free border, care being taken to cut off a good piece. The plan I now always follow when the knife reaches the red border of the lip, is to turn its edge obliquely towards the cleft, thereby saving a portion of the mucous covering of the lip, and lessening materially the notch in it (Fig. 173). The incision then having been made, and any bleeding vessel twisted, the surgeon should proceed to adjust the parts, and he had better commence at the free margin. When pins are used they should be fine, with flat heads, and one should be introduced about a third of an inch from the margin of the wound and brought out just under the mucous lining of the lip, reintroduced on the opposite side and passed through the lip. The edges can then be brought together by means of a twisted suture, care being taken to adapt accurately the parts at the red margin of the lip. If this end be attained, the second and third pins should be inserted above, one close to the nostril, the second between the two, and both fastened separately. If the interrupted silk, gut, or horsehair suture be employed instead of pins, a practice I greatly prefer, having given up pins in simple cases, it is wise to introduce a needle as the first pin to adjust the parts, and then insert the second and third stitches, putting in afterwards the marginal suture by simply drawing the needle that had been introduced as a pin through the flaps. In some cases, it is serviceable to insert a fourth suture into the red border of the lip itself.

Mode of operation.

Use of pins.

Use of sutures.

Fig. 173.



Operation for single harelip.

Fig. 174.



Hainsby's truss.

Hainsby's truss.

After the operation Hainsby's truss should be employed when possible (Fig. 174). It keeps the parts well together and prevents any traction upon the wound. It is an invaluable instrument. When it cannot be obtained the cheeks should be well drawn forward and held by some good plaster applied either from ear to ear or from the temple on one side beneath the chin to the temple on the

other. When pins are employed this practice can hardly be followed. The sutures or pins may generally be removed about the second or third day at the latest, and, after their removal, the cheeks must be held forward by strapping.

Collis's suggestions and mode of operating.

Mr. Maurice Collis, in 1866 ('Dub. Quart.'), in an able paper on harelip, among other points laid great stress upon the propriety of utilising the parings. He never threw away a particle of them but used them all. I have followed his suggestions in many cases with admirable success, and am disposed to think that where the lips are thin his method is of service. His operation is as follows:—He first made an incision from A to B (Fig. 175), through the thickness of the lip down to the mucous membrane, but not through it, and turned the flap back. On the other side, he transfixed the lip at C, and separated the flap as far as D, dividing the flap in the centre at E. He then brought the two sides together, the loose lateral flaps covering in the semi-attached one in the central bit. The upper flap C E was fixed by a suture to A, and the lower flap E D to B. Two intermediate sutures being applied (Fig. 176), I thus obtain, says Collis, "a lip nearly double in depth what I could possibly have got by the ordinary incisions." Malgaigne's

Fig. 175.

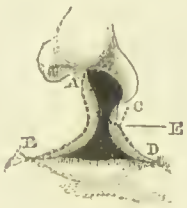


Fig. 176.



Collis's operation for harelip.

operation is, in a measure, somewhat similar to the above, utilising as it does the flaps of skin by turning them down and stitching them together (Fig. 177). In some cases, one of the pared edges may be left attached and united with the opposite side that has been sloped to receive it. This suggestion I had from Mr. Dix, of Hull, in 1859. ('Med. Times and Gaz.,' July 2nd.)

Malgaigne's operation.

Fig. 177.



Operation for double harelip.

Malgaigne's operation. From Holmes.

Double harelip.—When this is uncomplicated with bone displacement, it can be dealt with as simple harelip. In a general way it is well to operate on both sides at once, more particularly, if the lower flaps of the lateral portions are utilised by being turned down and united beneath the central piece (Fig. 179). If there be, however, much separation, and, consequently, traction upon the lateral portions, the operations upon the two sides should be performed separately.

When the intermaxillary bones project to any extent and are separated from the maxillary, there will be some difficulty in the treatment. I believe the better plan is to remove them with the knife or scissors, for when broken and bent back, the central incisor teeth too often

Mode of dealing with the projecting bone.

grow in some abnormal position and are in the way. When removed, the maxillary bones subsequently approximate, and the lateral incisor teeth frequently assume the position of the central. Sir W. Fergusson latterly removed these bones, or the milk tooth with its bony bed, subcutaneously, and, I think, with advantage. When they are pushed so forward as to form a kind of appendage to the tip of the nose, as seen in Fig. 180, they ought to be removed. The portion of skin over the bones, however, must always be utilised, either to form a columna nasi where none existed, as in Figs. 181 and 182, or, to be brought down, and inserted between the two lateral portions of the lip.

Fig. 178. Fig. 179.



Operation for double harelip.

Utilise central skin.

When primary union fails, the surgeon can often succeed by scraping the surface of the wound and re-applying the sutures; and he may do this, although the parts have sloughed at first as soon as healthy granulations appear.

Fig. 180 Fig. 181. Fig. 182.



Before operation. After operation.

(From patients.)

Cheiloplastic Operations.

Cheiloplastic operations on lip.

These are demanded for deformity of the mouth from destructive ulceration or sloughing, as from cancrum oris, and are somewhat similar to those for harelip. When undertaken for contraction of the mouth, the surgeon should always try and turn up from within the mouth, some portion of the mucous membrane to cover over the new angle, and thus prevent its subsequent contraction. I have done this in several cases with gratifying success; one of which is figured below. The deformity was the result of sloughing after fever. At times new tissue must be brought up from the chin or down from the cheek. Indeed,

Fig. 183. Fig. 184. Fig. 185.



Deformity result of sloughing. After first operation. After second.

these cases tax the ingenuity of the surgeon to the utmost, as no general rules can be laid down regarding them; each requiring to be

dealt with on its own merits. But this much may be said, that no part of the body heals so rapidly or so well as the face, and in none are plastic operations more satisfactory.

Cancer of the Lips.

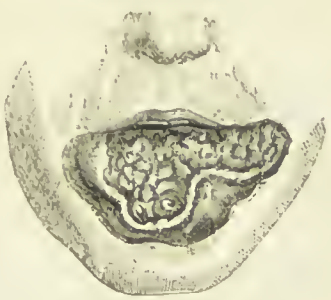
This term is generally applied to epithelioma or cancroid disease, true cancer or carcinoma being very rare. It is a disease of middle life, four out of five cases attacking patients between forty and sixty years of age. The youngest subject I have seen affected by it was a sweep æt. 27, and the oldest also a sweep æt. 86. It affects the lower lip more frequently than the upper in the proportion of 25 to 1, and men more than women. In my own table of fifty-four consecutive cases, three instances of the latter exist, to fifty-one of the former. Cancer of lip. Period of life

Smoking, or rather the irritation of a pipe, has generally been ascribed as a common cause, and it is probable that such an irritation is sufficient to set up the disease when a predisposition to its development already exists. It is interesting to note, however, that in fifty-four consecutive cases in which I made the inquiry nine, had never smoked, and this proportion is probably, in this country, about that of the non-smokers amongst the male population. Causes.

The disease generally commences as a dry scab on the red margin of the lip; and it may be that this scab forms over a crack or excoriation, but as often as not it appears alone; occasionally too it commences as a wart. In its early stage the progress of the disease is generally very slow, and only when some ulcerative action appears does it develop more rapidly. It is under these circumstances that the patient first applies for advice, in the dry stage, the disease is passed by unheeded. Origin and progress.

The appearance of an epithelial cancer is tolerably characteristic (Fig. 186); it has generally an irregular warty aspect, but, when ulcerating, has thickened everted edges. It has always a well-defined indurated base. When ulcerating, it discharges a sanious pus containing epithelium scales in abundance, and when dry, it is covered with a scab of the same material. Microscopically it contains epithelial elements arranged in capsules. (*Vide* Fig. 32.) Appearance of an epithelial cancer.

Fig. 186.



Cancer of lip in John C—, æt. 54. From drawing.

In its early stage it seems to be a local disease and rarely affecting more than one part at the same time. I have, however, seen several cases in which two separate centres existed, and one in which there were three. In the latter, two growths on the lower lips were excised, and nine years subsequently a similar disease attacked the tongue, which I removed in June, 1870, with the galvanic cautery écraseur. Multiple cancers.

When the ulceration stage has set in, if the disease be left to run its course, the glands beneath the jaw will probably soon become affected. Indeed, under these circumstances, the progress of the affection will be steady, if not rapid, and goes on to destroy all the tissues with which it comes in contact—integument, gums, bone, teeth, and glands. It Enlarged glands.

destroys life by exhaustion, and may do so by sceondary deposits in the lungs or viscera, but far less frequently than in carcinoma.

Treatment. TREATMENT.—There is only one treatment that can be recommended, and that is, the speedy removal of the disease. When once the nature of the case is clear the sooner the growth is taken away the better; and, in doing this, the surgeon must also deal freely with the surrounding Excision. parts. He had better err by removing too much than too little of the surrounding tissues. To tease the parts with mild caustics is bad practice, as it merely irritates and rarely destroys the whole growth. Caustics not advised. Caustics cannot, as a rule, be recommended. Excision is probably the best method. When the disease is superficial, it may be sliced off, leaving the parts to granulate; when it involves more of the lip, a V-shaped piece may be taken out, the two edges being brought together as in harelip. When much of the lip is affected, the whole must be removed, and a new lip formed by bringing up the soft parts from the chin as indicated in Figs. 187, 188.

Removed by the galvanic cautery. I have, however, with the galvanic cautery removed many superficial cancerous tumours of the lip with success, having isolated the growth with pins, and then removed it with the wire passed beneath them.

Recurrence of disease. After the removal of the disease, a cure may follow; but in the

FIG. 187.



Diagram showing the lines of incision for new lip after removal of a cancer.

FIG. 188.



Diagram showing position of flaps when brought up.

majority of cases, a return takes place, and generally in the same spot. Similar treatment must again be resorted to, even to a second and third operation, as there seems reason to believe, that, after each operation, a longer interval of immunity may be promised. Thus, a man who had a cancer of the lip removed a year after its appearance was well for two years, when a second operation was required. He remained well for three years, when a third was performed, and this time four years elapsed before a return took place. It was then excised for a fourth time.

In another case, a man, æt. 65, had a cancer of his lip removed fifteen years before he came under my care. He remained well for eight, when, the disease returning a second operation was demanded; and seven years after this he was well. Epithelioma of the lip is of slow growth. I have removed one from a man, æt. 74, of twenty years', and another from a man, æt. 50, of eight years' growth.

Horny growths. Horny growths may spring from the lip as from other parts of the cutaneous surface. (Prep. 1678[5], Guy's Hosp. Mus.)

Chancres, syphilitic or otherwise, are at times met with on the lips, and so the surgeon should be on his guard not to mistake them for cancer. They have neither the clinical history nor aspect of such an affection, but make much more rapid progress. They are likewise usually attended with considerable inflammatory swelling as well as with secondary glandular enlargement. They are, moreover, usually met with in younger subjects than is cancer. When syphilitic, the constitutional symptoms will mark their true nature. Chancre on lip.

Hypertrophy of the Mucous Glands of the Lip.

The mucous covering of the lip is often found to be thickened, two elevated or pendulous portions of tissue appearing, one on either side of the middle line. This condition authors have described as *Hypertrophy*, though the name does not appear to be correct, for, on removing the so-called hypertrophied mucous membrane, a number of small granular bodies the size of hemp-seeds, and made up of gland-cells, are always found underlying a healthy mucous membrane. The disease appears, therefore, to be due to an increase in the size of the natural glands, and not of the mucous membrane of the part (Fig. 189). It should be treated only by the careful excision of the diseased submucous tissue—the incision being made in the line of the lip, and the edges brought together by fine sutures. I have seen as many of such cases in the upper as in the lower lip; and rarely does it involve both lips. I have never known it to recur. Hypertrophy of the mucous glands.

Fig. 139.



Hypertrophy of mucous glands of lip.

A genuine hypertrophy of the lip itself is a common affection. It often begins as a chronic inflammation of the part, or rather œdema, the inflammatory deposit becoming organised. There can be little doubt that many of the so-called thick strumous lips have this origin. Attention to the general health and its improvement are the means by which any cure may be expected.

Cystic Tumours of the Lip.

Mucous cysts are often seen and generally in the lower lip. They appear as tense, globular, and at times semi-translucent tumours beneath the mucous membrane, and are readily cured by excision or by cutting off their upper wall by means of scissors and sharp-pointed forceps. An incision into them rarely does good. They contain a glairy mucoid fluid. On several occasions, I have turned out of the lip, from beneath the mucous membrane, solid encysted tumours, with a glandular structure. Cystic tumours of lip. Adenoid labial tumours.

Nævi of the lip are often seen, and when they involve the whole thickness of the part their excision by a V incision is the best treatment. I have done this on many occasions with a beneficial result. When they are only superficial or beneath the mucous lining, they may be treated locally, as already mentioned in the chapter on nævus. Nævi.

Phlegmonous inflammation.

Phlegmonous or carbuncular inflammation of the lip is an alarming affection; it is never found except in the feeble and cachectic. It attacks the upper as well as the lower lip, and shows itself as a general infiltration of the part, which becomes enormously swollen, tense, and painful. When seen in an early stage a free incision into it or its mucous surface gives relief and expedites the sloughing of the cellular tissue that is sure to follow. Fomentations and warm-water dressings are the most beneficial, with good living and tonics, such as quinine and iron in full doses. At times this affection ends in sloughing, and then puts on the appearance of what is called cancrum oris. It is very prone to be followed by septicæmia.

Cancrum oris.

Cancrum oris, or gangrenous stomatitis, is generally met with in the ill-fed and feeble child after one of the exanthemata. It is seen also where mercury has been given to salivation. It commences often as a phlegmonous inflammation of the cellular tissue of the cheek or lip, going on rapidly to sloughing and phagedænic ulceration, or, to sudden death of a part of the cheek, the tissue becoming white and bloodless, and then sloughing. At times, this sloughing process will involve a large portion of the cheek, and even of the gum or bone. It is a most fatal and dangerous disease. Before the sloughing has taken place, the part involved will be much thickened and indurated. It will feel of a brawny hardness, and appear of a dusky colour in the centre, with a red border. When the skin covering in the dead cellular tissue has sloughed away, a deep, excavated, irregular surface will be seen discharging an offensive sanious fluid, and, if the disease spreads, it does so by sloughing and ulceration (Fig. 190). It generally kills by exhaustion, sometimes by bleeding from the sloughing of an artery.

Fig. 190.



Cancrum oris.
Model 26⁵, Guy's Hosp. Museum.

Treatment.

Treatment.—The general treatment is, tonics and good feeding, milk, eggs, and wine, beef tea, and any other nutritious food being of primary importance. When food cannot be taken by the mouth it must be given by the bowel as enemata. Tonics also must be administered, as the liquor cinchonæ, quinine, or iron, in such doses as the child can bear.

Locally, till the slough has separated, little more than fomentations and cleanliness can be employed; but when the sloughing and ulceration spreads the application of strong nitric acid is of great value. It must, however, be liberally brushed over and into the parts so as to destroy all their surface and induce a fresh action.

Absolute cleanliness should be observed, the wound being washed and irrigated by means of a steady stream of water to which carbolic acid 1 part to 20, Condy's fluid, chloride of zinc, or nitric acid in the proportion of ɱv to the ounce of water may be added. When recovery takes place, it is frequently with the loss of large portions of the affected parts, for which some plastic operation will subsequently be required.

Aphthous stomatitis is another affection often mistaken for cancrum oris, but is not, however, half so dangerous. It occurs likewise in the unhealthy and ill-fed child, but as often as not is independent of the exanthemata. It begins as an aphthous ulceration of the tongue, gums, lips, or cheeks, by which these parts become covered with a white or ash-coloured secretion. With these local symptoms there will be a foul tongue and fœtid breath, as well as some evident symptoms of derangement of the bowels and digestive organs. In very feeble children this superficial ulceration may pass on to sloughing of the parts, or *ulcerative stomatitis*, thus simulating *cancrum oris*, but with this difference—in *cancrum oris*, the disease begins in the cellular tissue, the skin sloughing subsequently; in *ulcerative stomatitis* or *noma*, it begins as a skin or mucous membrane ulceration, sloughing following upon it. Aphthous stomatitis.

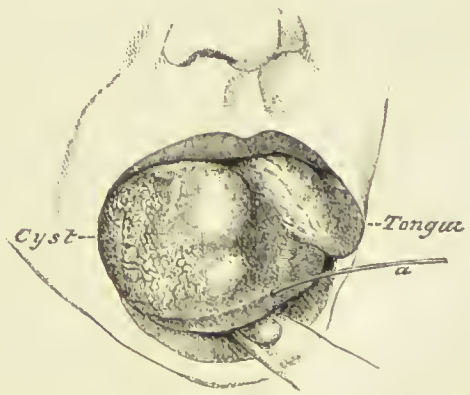
Treatment.—Of all drugs, the chlorate of potash has the best action, and should be administered in five- or even ten-grain doses mixed with bark, or with milk, a lotion of the same drug, ʒj to a pint of water, being used as an application. Milk diet is the best where it can be taken, beef tea and eggs being given otherwise, or, in addition. Wine must be administered with great caution, and only when the powers of the child are very feeble, as in the phagedænic form. A rhubarb purge is usually required at the beginning of the affection to clear the way, as foul excreta are too often present, and, in the later stage, the more powerful tonics, such as iron or quinine, are often demanded. It is a disease generally due to intestinal irritation from bad feeding, and requires, therefore, for its treatment, careful attention to this matter. Treatment of stomatitis.

Ranula or Sublingual Cysts.

Ranula.

These are now known *not to be* due to any obstruction of the salivary ducts, submaxillary or sublingual, but to obstruction of one of the mucous glands situated beneath the tongue, such as the glands and ducts of Rivini. They are probably analogous to the mucous cysts of the lip already alluded to, and of the mucous passages generally. They contain a clear, glairy, mucoid fluid, but never saliva. I have the notes of several that were *congenital*. They sometimes attain a large size, and, when placed beneath the tongue (their usual Nature of the disease.

Fig. 191.



Ranula or sublingual cyst, with salivary duct lying upon it.
Guy's Hosp. Mus., No. 2293⁶.—Hilton's case.

position), the salivary duct can readily be traced lying over them (Fig. 191). Sometimes they are multiple, and, on several occasions, on opening one cyst, I have seen a second within. When neglected and allowed to increase, they may so press the tongue upwards as to prevent the patient speaking, or, they may form a large swelling beneath the jaw.

Character. Within the mouth they appear as semi-transparent cysts beneath the tongue, and they are, as a rule, painless and merely give trouble mechanically. When opened a glairy mucoid fluid escapes. This operation, however, rarely is serviceable as the fluid re-collects. The best Treatment. treatment is, to raise the upper surface of the cyst by means of a pair of pointed forceps or a tenaculum, and with scissors cut off its upper surface. M. Panas, of Paris, has lately injected these cysts with three to ten drops of a solution of chloride of zinc (45 grains to an ounce of distilled water) with success. In large tumours the cavity may be plugged with lint soaked in iodine after it has been freely incised. The application of a seton is at times beneficial though an uncertain remedy; simple plugging of the cyst was a mode of treatment that I formerly employed till I discovered that the plans above suggested were preferable. It is next to impossible to excise them, as they have no definite walls.

Sebaceous sublingual cysts. Encysted tumours are, however, met with beneath the tongue. I have had two under care, and both I mistook for ranula. The error was discovered only on opening them; and in both, on making my incision, I had to cut through the mucous lining of the mouth over the cyst, and the cyst-wall itself. From both a cheesy sebaceous secretion escaped.

These tumours have nothing to do with ranula, have distinct capsules beneath the mucous membrane, appear to be sebaceous, and are probably congenital. In the cases I have mentioned, the patients were under twenty years of age. In both I pulled out as much of the cyst-wall as I could, dissecting it from its bed, and in one with complete success. In the second a return followed, which called for another operation, which was crowned by a good result. I have never known any of these sublingual cysts require removal from below the jaw; though the sebaceous form might do so. In one of my cases I contemplated this plan, and Sir W. Fergusson gives a case where it was adopted. It is probable, that plugging of the cyst, to set up suppuration, would be a simpler and equally efficacious practice.

Salivary Calculus.

Salivary calculus. The salivary ducts beneath the tongue may be obstructed in exceptional cases, from the introduction of foreign bodies, but more commonly from *calculus*. Steno's duct or that of the parotid may be thus affected, but the Whartonian or the sublingual salivary duct is that more Symptoms attending. commonly involved. When the obstruction is complete patients complain during deglutition, of pain in the corresponding salivary gland, with some swelling, such symptoms being clearly due to retained salivary secretion; and these soon subside on the completion of mastication. In exceptional examples suppuration may attack the gland.

The calculus depicted in Fig. 192 was taken from the sublingual duct of a man by my friend Mr. C. Sells, of Guildford, and weighed 48 grains.

This affection can usually be easily recognised on the application of the finger beneath the tongue, the calculus, as a rule, holding a superficial position. On feeling the stone, the surgeon may often with his nail tear it out of its bed. I have removed several by this plan when not larger than hemp-seeds. When larger, the best plan is incision, the surgeon being careful to cut through the duct where it seems to be thinnest, and scoop the calculus out of its bed by means of a director or bent probe. These calculi may attain considerable dimensions, even one inch long. On one occasion, I broke a calculus to pieces, in attempting to remove it from the centre of a suppurating subliugual gland of a man, æt 42, who had had evidence of its presence for years. He came to me with the parts hard as well as ulcerating, having been told he had a cancer, and a rapid recovery followed its removal. Occasionally after the removal of a calculus from a salivary duct a stricture results, when the gland under stimulus may inflame and be the source of trouble. A free division of the duct is then the right treatment to adopt.

Diagnosis.

Treatment.

FIG. 192.
Nat. size



Salivary calculus, weighing 48 grains.

Size of calculus.

Stricture of salivary duct.

Salivary Fistula.

Salivary fistula.

When Steno's duct, the duct of the parotid gland, has been obstructed near its orifice in the mouth, or has been opened by a wound or ulceration, a salivary fistula may take place, that is, the saliva, instead of being poured into the mouth, will escape upon the cheek. When this affection originates in some obstruction to the duct itself, it will commence as a soft fluctuating swelling in the cheek caused by retained salivary secretion; and, after a time, usually when the duct has acquired about the size of half a walnut, the swelling will ulcerate through the skin, and clear saliva or saliva mixed with pus will escape. If this swelling be opened the same result will ensue, and after this, the cavity may contract, but the fistula will remain.

The only successful treatment of this affection is, to establish a free opening into the mouth from the oral end of the duct, which may be effected by passing a fine probe into the fistula through the duct into the mouth. When this can be accomplished through the natural opening all the better, but it is not a matter of much importance, as artificial opening near the oral orifice of the duct will answer every purpose. The probe should be armed with a piece of thick silk, or three or four threads of fine silk, and drawn through the mouth, the ends hanging from the cheek and those from the mouth being tied together, the whole acting as a seton to establish an artificial fistulous communication with the mouth. This object will probably be secured in about a week or ten days, when the seton may be removed. The fistula in the cheek will then probably contract and close of itself; but if this does not take place the edges of the fistula may be cauterised by the galvanic, gas, or actual cautery, and thus cicatrisation be encouraged. The operation may be repeated if required. A plastic operation may be attempted when these means fail.

Treatment.

I have known *parotid* salivary fistula follow upon the suppuration of the gland after fever in three cases; the orifice in all being small and placed behind the angle of the jaw. In none of these was it

Cervical salivary fistula.

associated with any obstruction to Steno's duct. It was troublesome only from the trickling of saliva during mastication, though to one of the patients, who was a lady, this caused much annoyance. I tried the cautery in one of these cases, but without success.

Mumps.

Parotiditis or "Mumps."

This is a simple, although an infectious, disease, having a tendency to get well with simple fomentations of the parts, a saline purgative, and a mild tonic. It is occasionally metastatic to the testicle. When it follows upon a fever, it is a severe affection, and not unfrequently passes on to suppuration; such abscesses spread easly, the deep fascia covering them in forbidding a natural outlet except by burrowing. Salivary fistula in the neck may follow in such a case. Professor Crocq, of Brussels, believes this disease is the result of a stomatitis propagated along the duct of the parotid gland to the gland itself.

Parotid and submaxillary tumours.

Parotid and Submaxillary Tumours.

These have one peculiarity, viz. that they are almost always more or less cartilaginous—the ordinary form of tumour in this region being the fibro-cartilaginous—they, moreover, are mostly encysted, having a peculiar hard, elastic feel and botryoidal outline. They are generally embedded in the structure of the gland, and vary much in their depth; tumours that appear moveable and superficial, too often dipping well down into the tissues and thus increasing the difficulty of their removal. These simple tumours may grow to a large size, and stretch the skin greatly over them, and should always be removed; the earlier the better. In removing them, the surgeon should be careful to make his incision well down to the capsule, when he will probably be able to enucleate the growth. It is far better practice to do this, even with the application of a little force, than to be too free with the knife, for the facial nerve is generally in close contact with the tumour and the deep vessels are beneath. He should also always cut upon the tumour, dividing only such tissues as hold it down, taking great care too that the large vessels are, if possible, left uninjured. In deeply placed tumours, this removal by enucleation is still more necessary. When the tumour is large, there is always a strong probability that the facial nerve will be divided or injured, hence it is as well to prepare the patient for the fact. Fig. 193 illustrates the situation and external appearance of one of these tumours.

Mode of removal.

Fig. 193.



Submaxillary tumour.

Cancerous tumours of the parotid.

Cancerous tumours of the parotid are likewise met with, but assume a very different appearance from the last. They are mostly infiltrations of the gland, fixed, diffused, and deep seated; they are, moreover, generally

associated with paralysis of the facial nerve, differing in this way from innocent growths. Never should they be surgically interfered with. Decision as to removal of tumours.

The difficulty of deciding as to the removal of large growths in this position is very great, and the best guide is their mobility. Sir W. Fergusson, who had had more experience in these cases than any man of modern times, says, "If it were evident that the part slid freely over the subjacent textures, I should not hesitate about using the knife, whatever might be the bulk of the disease," &c.; "but if the tumour seemed fixed, its limits were not clearly defined, or an attempt to move it caused pain, I should not readily be induced to use the knife, however small the mass might be," and I endorse these views.

AFFECTIONS OF THE TONGUE.

Affections of the tongue.

Tongue-tie is occasionally met with, but not a tithe of the cases so ascribed are of this nature. It is due to a tying down of the tip of the tongue by the frænum linguæ, which prevents the infant from projecting the organ beyond the gums, thereby interfering with sucking. It is easily remedied by dividing the frænum perpendicularly downwards behind the gum with a pair of blunt pointed scissors, the point of the tongue being elevated with the finger, or a pair of dressing forceps applied beneath. Tongue-tie. Treatment.

Wounds of the Tongue.

These are sometimes troublesome from hæmorrhage, but, when the parts are brought together the bleeding as a rule ceases; sutures should always be employed when gaping exists. If, however, a bleeding vessel be visible, it ought to be tied or twisted. The sutures must be put in deeply to draw the whole thickness of the divided parts together. On one occasion, owing to a neglect of this practice, I had to pare the surface of an old wound of the tongue that had passed through the half of the organ transversely, and then bring the parts together. The child was clearly unable to talk on account of the injury; yet after the operation, all was well. When bleeding is obstinate and the parts cannot be brought together, the cautery or perchloride of iron may be usefully employed. In exceptional cases the ranine artery may require a ligature. Ice in the mouth arrests slight hæmorrhage. Wounds of tongue.

Hypertrophy of the Tongue.

This is a troublesome affection, chiefly from the mechanical obstruction which it causes, is chiefly found in young subjects, and is sometimes congenital. It has been ascribed to chronic inflammation of the organ, but that such is invariably the case appears doubtful. When it has existed for years, it may cause distortion of the jaws. It may involve the whole organ or only half. In a case I had under my care not long ago, this latter condition was singularly well illustrated. It is to be recognised simply by the increased size of the organ, no external evidence of disease usually existing. The enlargement, as a rule, is painless, though when the tongue cannot be kept in the mouth, the disease is distressing. It is not often amenable to treatment. In the case of a boy, æt. 6, who was originally under the late Dr. Addison's care at Guy's for a congenital enlargement of the organ, the perchloride of mercury in small doses reduced the size of the organ so as to allow of its return into the mouth, and, although several relapses took place in later years, the same treatment was repeated with Hypertrophy of tongue. Treatment.

equally good results. In a gentleman, æt. 20, who consulted me some years ago for enlargement of the tongue of twelve years' standing, attended with protrusion and all its evils, iodism induced by ten-grain doses of the iodide of potassium was followed within a week by the speedy disappearance of the affection, though at the time death appeared imminent from the excessive swelling of the organ caused by the drug. In other cases the removal of a wedge-shaped piece from the centre of the organ is the best practice; while to cut off the projecting portion is far less satisfactory. The application of ligatures to the lingual arteries to starve the disease might possibly be of service in such cases.

Tumours of the tongue.

The tongue may likewise be the subject of *ichthyosis*. Sir James Paget, Mr. Hulke ('Trans. Clin. Soc.,' vols. ii and iii), and Mr. Morris ('Brit. Med. Journ.,' 1874) have recorded examples of the affection. Many have come under my notice. They have a disposition to pass into cancer, and the case from which Fig. 195 was taken was of this nature. When cancer attacks the ichthyotic tongue, it is generally of a virulent form, and any operation for its relief is too often followed by a rapid recurrence of the disease, either in the part or in the cervical glands. An ichthyotic tongue, therefore, should be at once removed as soon as the slightest evidence appears of its being the seat of cancer. Cases are also on record of *fatty tumours*, of *warty growths*, and congenital *pedunculated* growths, *fibro-cellular* and *adenoid tumour*, and *hydatid of the tongue*.

Glossitis.

Glossitis.

Inflammation of the tongue when deep seated and general is a grave affection, as the swelling may be so sudden and severe as to threaten life by suffocation. In the sudden enlargements from the salivation of mercury or iodism, as in a case already given, these symptoms are at times seen, but, as a rule, they subside rapidly under local fomentation on the removal of their cause. If suffocation be threatened by the œdematous enlargement of the organ, free vertical incisions might be required, though I have not yet seen a case where such a practice was demanded. Inflammation ending in local suppuration is far more common; and, when an abscess has formed, the sooner it is opened the better. If it be situated at the root of the tongue, both deglutition and speaking will be interfered with; indeed, the abscess may mechanically so press upon the epiglottis as to close the larynx, and threaten life.

Abscess of tongue.

Local inflammation of the tongue may arise without any known cause, or from the contact of some irritating substance, such as that of tobacco. It may also follow a wound.

Treatment.

Treatment.—Fomentations to the part frequently applied, and an incision into the abscess as soon as it can be made out, are the best local means. Tonics after the use of a mild purge are also useful. When the swelling becomes dangerous by its pressure, the œdema may be dispersed by an incision or puncture, but the surgeon need be in no hurry to adopt this practice; it is rarely needed. My late colleague, Mr. Poland, had a case in which incisions were followed by very serious hæmorrhage. The application of leeches to the organ when projecting has been followed by rapid relief.

Aphthous inflammation.

Aphthous inflammation

of the tongue, and superficial ulceration are not uncommon. It occurs in children chiefly from alimentary irritation, and is curable by the chlorate of potash internally in five- or ten-grain doses, like aphthous stomatitis.

Simple ulcer.

Simple or dyspeptic ulcer of the tongue is a rare and very obstinate affection. The few cases that I have seen of it have been in adults in whom considerable disturbance of the digestive apparatus existed. In one, the patient passed lithic acid in such abundance as to startle me. He used to bring it in spoonfuls weekly. The ulceration may be extensive, but always superficial, and the tongue is usually glazed with it and often red. To the touch it does not feel hard.

Treatment. Treatment.—The only sound treatment is a soothing one. The bowels should be attended to by means of a mild purgative such as castor oil, and rhubarb and magnesia, or alkalies given, such as the bicarbonate or chlorate of potash in gentian, calumba or bark. The diet should be regulated in the most careful manner, and all food forbidden that can possibly irritate. Milk, when it can be taken should be allowed. Beer and spirits are generally injurious; but wine may be allowed when necessary. Locally, the chlorate of potash lotion is the best. Caustics and other stimulants are rarely required.

These cases are not to be mistaken for the syphilitic or condylomatous affections of the organ which are less superficial, more raised and indurated, and are, besides, usually associated with patches on the throat, lips or cheek, and other constitutional symptoms; nor with the fissures or ulcers that are often found at the side of the tongue, due to the irritation of a stump or tooth.

Deep ulcers.

Deep-seated ulcers of the tongue.

These may be *simple*, *syphilitic*, or *cancerous*. The first is very uncommon, and usually the result of a local abscess. It can be known by the sharpness of the edges of the sore, the abscence of induration, and the fissured aspect of the ulcer. It has a tendency to recovery.

Syphilitic ulcer. The deep-seated syphilitic ulcer is generally the result of a breaking down of a gummatous tumour in the thickness of the organ. As a tumour, it appears as an induration of the part; and as an ulcer, it appears deeply excavated with irregular but not infiltrated or everted edges. It is slow in its progress and not so painful as cancer. It is usually found also with a history or with symptoms of syphilis, and occurs chiefly in the body of the tongue. It can be mistaken for a cancer, and I consider most of the cases of so-called cured cancer of this organ are of this nature.

Cancer of tongue.

Cancer of the Tongue is usually epithelial, and may occur in a person the subject of ichthyosis. It is most common between forty and sixty years of age; and like cancer of the lip, is more frequent in men than women, in the ratio of five to two, generally commencing in, and confined to, one side of the organ; an analysis of fifty-five cases ('Just. Schmidt's Jahrb.,' 1860) proving that it involved both sides only in nine. It begins more frequently as a crack or ulcer than as a wart, and soon causes pain. It increases with variable rapidity, though the majority of patients seek advice only after it has existed a few months. It is usually recognisable by the irregular surface of the sore, its indurated and often everted edges, its hardened base, and sloughing surface. As time goes on the glands beneath the jaw become enlarged, the disease infiltrating all the tissues as it increases, and the patient's powers becoming enfeebled; hæmorrhage from some large vessel too often in the end destroys life.

Treatment of cancer of tongue.

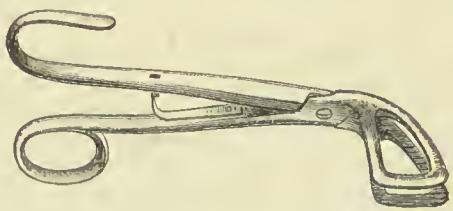
TREATMENT.—It is now admitted that the sooner the disease is removed the better, as there seems good reason to believe that it is at first a local affection, and that after its removal a cure may be obtained. If this end be not secured, much benefit will be gained by the operation, as it relieves a patient for a time, from a most distressing and exhausting affection; and, should a return take place, it is more likely to do so in the glands than in the part—while death, under these circumstances, is less painful. The operation, moreover, is attended with marvellously little risk to life, and is followed by improved articulation even when the whole organ has been removed. In the case figured (Fig. 195) the man could speak as well after as before the operation. There are only two modes by which this removal *should* be effected, *excision* and the *écraseur*. Caustics are painful and uncertain, consequently have been rightly abandoned. The ligature is painful and tedious, and, beyond the freedom from hæmorrhage, it has no advantages; and in this is only equal to the écraseur. In excision the surgeon using knife or scissors must be careful to remove the whole of the diseased part, cutting well beyond the limits of the tumour. At the same time, when a portion of the organ only need be sacrificed, no more should be removed than necessary. It is wiser, however, to remove too much than too little.

Caustics.

Ligature.

Excision.

FIG. 194.

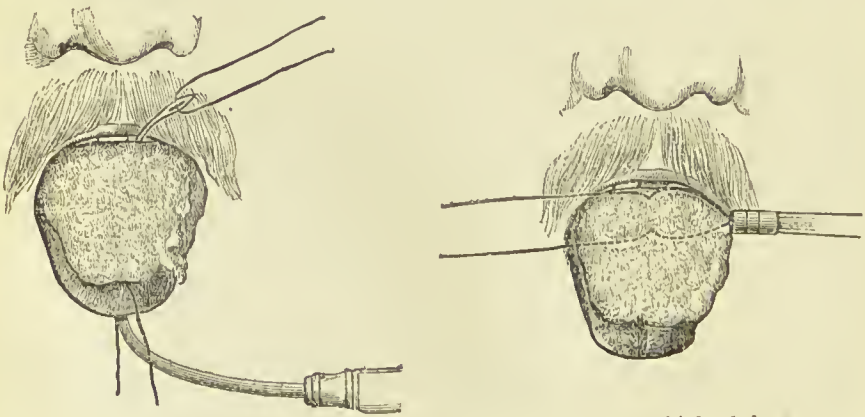


Tongue forceps.

Mode of performance.

When the disease is limited and in front, excision may be employed, for with the tongue held well out by a suitable pair of forceps (Fig. 194), or by a ligature passed through the tip, all vessels can be tied or

FIG. 195.



Drawing showing the operation for the removal of the anterior two thirds of the tongue.

twisted and bleeding controlled. When the galvanic écraseur, or écraseur wire heated by the galvanic battery can be obtained, no better means can be found for removing small or large portions of the tongue, and since I have employed them I have given up excision. With pins put in to isolate the growth, and the wire carefully adjusted behind them, any sized mass may be readily removed by a bloodless operation. Some prefer, however, the ordinary wire écraseur. Both instruments are good. The amount that can be removed through the mouth by these means is measured only by the appliances the surgeon has at his command to fix its posterior boundary. In the case figured above more than the anterior two-thirds of the tongue were removed, and, by means of the curved needle shown in the drawing, no difficulty was experienced in passing the ligature, or in removing the organ. When the diseased tongue cannot be excised with safety, or its base isolated and surrounded with certainty, through the mouth, various expedients have been suggested. Professor Syme divided the lower lip and jaw in the median line to give room for the operation (A to B, Fig. 196). Regnoli, of Pavia, made an incision from the hyoid bone to the chin, and two lateral cuts from the anterior extremity of this along the lower border of the jaw (B to E and C to D, Fig. 196), dividing through to the mouth all the tissues that connected the tongue with the lower jaw at the symphysis, thereby giving abundant room to draw the tongue downwards. Nunneley, of Leeds, introduced beneath the jaw between its base and the hyoid bone, a sharp-pointed curved knife, four inches long, and brought it out in the mouth at the frænum linguæ (N, Fig. 196). With a probe guided upon this knife he then drew through the wound the wire rope of the écraseur, drawing a good loop through the mouth and withdrawing the probe, the two ends of the rope hanging beneath the chin. He then seized the tongue with forceps, forcibly pulling it out of the mouth, and pushed through the base of the tongue three long and strong pins, making their ends appear in its upper surface near the base, and behind the disease. He then passed the loop of the écraseur behind the pins and drew it tight, thus completely encircling the whole organ. The process of removal then went on. Sir J. Paget improved upon this, in doing away with the submental puncture, and giving freedom to the tongue by dividing the soft parts that hold it down at the floor of the mouth close to the bone, thus allowing the organ to be pulled well forward. At the same time he rightly insisted that care should be taken to divide the tongue perpendicularly through its thickness, and not obliquely; this point, however, is guaranteed by the introduction of pins as already mentioned. Collis, of Dublin, instead of using the knife as suggested by Paget to divide the sublingual tissues, employed the écraseur. He has, also, advised that the cheek be laid open from

Galvanic écraseur.

Division of the jaw.

Syme's operation.

Fig. 196.



Illustrating the different operations for the removal of a tongue.

Nunneley's operation.

Paget's improvement.

Collis's mode.

below its angle to give room for manipulation when the disease is far back (F, Fig. 196). By one or other of these means, room can be obtained to free the tongue from its attachments, to isolate the growth by pins, and remove it by the écraseur—wire rope being used when the galvanic cautery écraseur cannot be obtained. I believe Nunneley's method to be the best, using the galvanic cautery écraseur when the disease is extensive. To isolate the disease, I have found the curved needle as seen in Fig. 195 introduced beneath the chin (N, Fig. 196) through the base of the tongue, behind the disease, to be very valuable.

Summary of modes.

When the disease is placed anteriorly, the introduction of pins through the mouth and the écraseur, are all that is required. When more room is necessary, Collis, Paget, or Nunneley's plans may be resorted to. When the disease cannot be isolated by these means, Syme's operation must be had recourse to, in which case it will be well to act on a suggestion of Sedillot's, and make the section of the jaw-bone irregular, to allow of a better adaptation of the segments afterwards than can be ensured when the line of division is vertical. The use of the knife had better be confined to the removal of small tubercles in the front of the tongue; all larger pieces being removable by the écraseur with equal facility, and with a smaller loss of blood.

When this disease cannot be removed, palliatives must be employed, and, among these, the removal of all teeth on the affected side of the mouth is most important.

Ligature of artery.

Ligature of the lingual arteries has been practised by M. Demarquay and others for the purpose of starving a cancerous tongue, occasionally too with a good result; yet such a proceeding is only applicable when the removal of the organ cannot be entertained.

Division of nerve.

Division of the gustatory nerve has likewise been practised with success by Hilton (1850), Moore (1861), and others, for the *relief of pain* in these cases. The nerve can easily be divided by an incision made between the last lower molar tooth and the anterior pillar of the fauces, behind, below, and parallel with, the alveolar ridge, as it descends from the coronoid process.

Fissures of the Palate.

On fissures of the palate.

The hard and the soft palate are liable to fissure, partial or complete, or both palates may be involved. It may be that the fissure appears as a mere notch in the alveolar process, in the line of junction of the superior maxillæ with the intermaxillary bone as is seen so commonly in harelip, or, it may pass backwards towards the velum; still on the other hand, the soft palate may show only a bifid uvula or a complete fissure. The fissures in the hard and soft palates are always in the middle line, although where they involve the alveoli, they diverge as they involve one or both intermaxillary bones; in fact, they invariably follow the line of suture, as seen in Fig. 165. Fissure of the soft palate alone is more common than that of the hard. Yet it is very rare for the intermaxillary bone to be so displaced, as seen in Fig. 171, without fissure of the palate. These malformations, when severe, give rise to much difficulty in sucking and deglutition, the food passing through the nose. They likewise interfere much with speech. Partial fissures are of little importance.

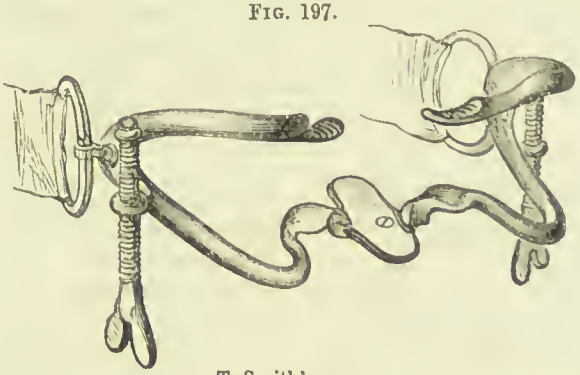
Treatment of fissure of palate.

TREATMENT.—When fissure of the palate co-exists with harelip, the lip may be operated upon as usual irrespective of the fissure, though it

will be advantageous for the patient to wear subsequently a Hainsby truss (Fig. 174) as the steady pressure of the pads has doubtless a good influence in bringing together the bones. Operations for the repair of the fissure have, till recently, been put off till the child was of an age to give assistance to the operator. Billroth was the first to operate in infancy, and did so with success on a child, twenty-eight weeks old, in three operations. In 1868, Mr. Thomas Smith introduced to the profession a gag (Fig. 197) that holds the jaws open and depresses the tongue, enabling the surgeon, (with the patient under the influence of chloroform,) to undertake the operation at a very early period; indeed, Mr. Smith has quoted cases where he operated at three years of age ('Med.-Chir. Trans.,' 1868; 'St. Barth. Hosp. Rep.,' 1871). It may generally be undertaken at the age of five, in a healthy child, and I have performed it successfully at four years of age. Operations when to be performed.

Roux was the first who practised the operation with advantage, having in 1819 successfully treated a medical student for cleft palate. Dr. Mason Warren, of Boston, did also much towards encouraging the History of operation.

Fig. 197.



T. Smith's gag.

practice; but, in this country, there is no doubt that to Sir W. Fergusson is due the credit of having demonstrated the value of the operation and of suggesting improvements therein. In his chief paper, published in 1845 ('Med.-Chir. Trans.'), he showed "how the *levator palati* on each side had such free and uncontrolled action that, whenever excited, it drew the margin of the cleft outwards and upwards, and so tugged upon the stitches put in by the surgeon that ulceration in their sites was a most probable result." He therefore suggested the division of this muscle in all cases, and that of the palato-pharyngeus in some. He did this by means of a curved knife (Fig. 198) passed through the fissure, so that its point can be laid on the tissues immediately above the soft velum, midway between its attachment to the bones and the posterior margin, and about half way between the velum and the lower end of the Eustachian tube. The point is then thrust deep, and carried half an inch or more backwards and forwards so as to cut the levator palati. By these Fergusson's method.

Fig. 198.



Fergusson's knives.

means, the palate is paralysed for a time, and so repair goes on with greater certainty.

Mode of performing the operation.

For fissures of the hard palate much has been done in more recent times. Dr. Mason Warren, in 1843, described the process of separating the hard from the soft palate with the view of its closure, though it has been left to Langenbeck, Billroth, Pollock, Avery, Lawson Tait, Annandale, T. Smith, and others, to perfect the process.

Chloroform.

The operation.—Chloroform is not necessary in a patient old enough to understand the necessity of being still and assisting the surgeon. In young children, with Smith's gag, it is an advantage.

Position of patient.

Of surgeon.

The recumbent position, with the head sufficiently thrown back, is probably the best, although some surgeons make the patient sit. The operator should stand on the patient's right side, or, in front. The steps of the operation have been hitherto as follows:—Pare the edges of the fissure; pass the sutures; paralyse the muscles; and fix the stitches. To pare the edges, a blunt-pointed bistoury is generally used, and a thin border of mucous membrane cut off from below upwards, the bifid uvula being held by a tenaculum-pointed forceps (Fig. 199). The incision also should be made as clean as possible. When it is made from above downwards, a sharp-pointed bistoury is needed. To pass the sutures, a corkscrew needle may be employed, or a curved needle flattened laterally (Fig. 200), with a slit in it for an eye, or an eye in the end. The lowest suture should be inserted first and both ends held—this practice facilitating the introduction of the others. The

Fig. 199.

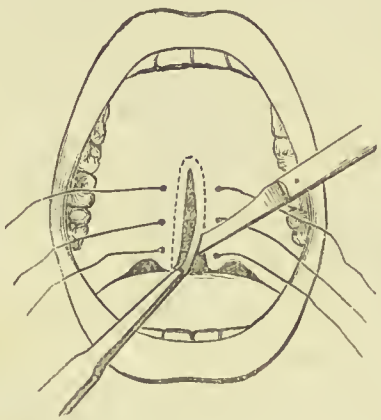
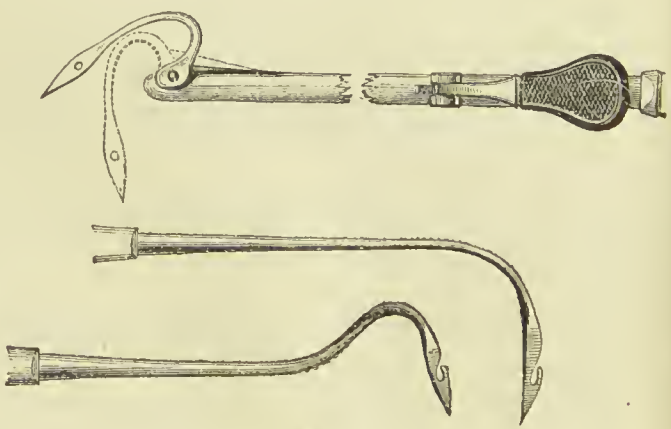


Fig. showing the paring of the edges of fissure after the introduction of the sutures.

Fig. 200.

Brook's needle.



Needles employed in fissured palate.

best material for sutures is fine gut; Mr. Smith uses horsehair for the lower stitches. I have rarely used anything but gut for all plastic operations since the year 1860, taking the precaution to select and to soak it in water for some minutes before using it. During the last two years I have as often used silk as not.

If Sir W. Fergusson's plan of paralysing the muscles be employed, it should be, as he advises, as a preliminary step to the operation. If Sedillot's or Pollock's plan be followed (Fig. 202), it may now be done by inserting a knife through the velum about a third of an inch from the highest suture, and cutting along the posterior edge of the hard palate towards the free margin, but not through it. This is the course I have until recently adopted. The two pillars of the fauces may then be snipped with scissors. The sutures have then to be fastened, and the best plan is, to run a perforated shot over the gut and clamp them, tying the ends of the gut in a knot to prevent the possibility of their slipping. I usually begin at the highest. Care should be taken not to draw the stitches too tightly. The parts should be sponged as little as possible, and the less manipulation there is the better; any irritation causing so free a secretion of mucus as to interfere greatly with the surgeon's proceedings. Rapidity in operating is consequently an

Mode of applying the sutures.

Fig. 201.

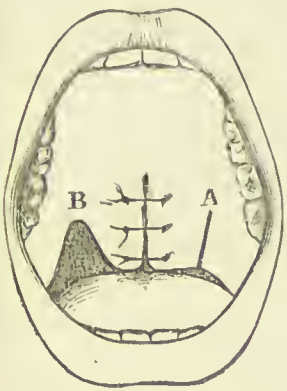
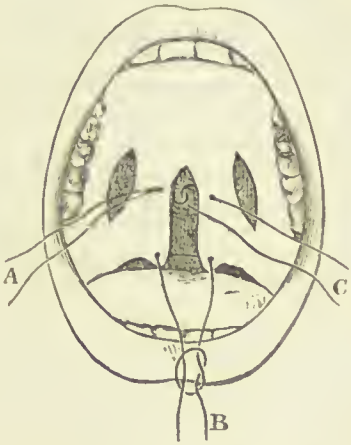


Fig. illustrating line of incision employed to relieve tension of the palate after the edges have been adjusted.

Fig. 202.



A. Avery's plan of passing sutures.
B. Fergusson's plan of fastening sutures.

advantage. When the parts require to be cleansed in the adult, iced water may be used as a gargle; and with a child under chloroform, the stitches may at times be inserted and the edges pared before any cleansing is required. In deep mouths where difficulty is experienced in passing the sutures, a clever manœuvre suggested by Avery may be called for, and is illustrated in Fig. 202; one end of the gut C is pulled through the soft palate and the end passed through a loop of silk (A) inserted on the right side; on pulling the loop the end C will be drawn through the right side. When silk is used, the double reef knot as shown at the lower part of Fig. 202, and generally adopted by Fergusson, is very serviceable.

New methods of procceding.

Lately, however, I have much simplified the operation, merely by altering its steps; that is to say, I have first introduced sutures through the soft palate, taking care to do so a quarter of an inch from the free horder of the fissure, and secondly pared the edges, employing for this purpose a pair of scissors with short blades placed at right angles to their shanks or a knife. By this practice, the introduction of the sutures is an easy proceeding, and, consequently, very rapidly effected, and the briuging together of the pared edges can be readily accomplished.

To relieve tension of the parts I now divide the soft palate laterally, as shown iu Fig. 201, A, the side cuts subsequently gaping, B, so as to appear as arches; so that iu this way the muscles of the palate are completely paralysed and the soft palate itself appears as one large uvula.

I have performed the operatiou already described on many occasions, aud with success. In none was there even a pin-hole left. Its simplicity is very striking. It cannot, however, be applied in all cases.

When stitches to be removed.

The stitches may he left in for five, ten, or eveu fourteen days, the amount of irritation being the guide to their removal. When union has taken place, the sutures only act as irritants, and in this as in all plastic operations, they should be removed as early as possible with safety. During the process of repair the patient may freely take soft food, swallowing hy no means tending to separate, but, on the coutrary, to close the wound. Stimulants may be given when

Patient to be in good health.

desirable. The operation, however, should only be uudertaken in healthy patieuts, whereas in the feehle it is almost sure to fail. After the operation the patient's friends should not be led to expect that an immediate change for the better will he traced in the voice, as such is never the case, indeed a loug iuterval of time as well as a process of education is necessary to acquire this result, although in many instances, the improvement is very great. How far an operation in iufancy tends iu this direction has uot yet hcen proved, sufficient experience in these early operations, as yet, not having beeu acquired.

Where a small opening is left.

If a small orifice near the hard palate he left after the operation, no necessity exists to interfere agaiu, because it is a clinical fact that they have a strong teudeucy to contract, and, the younger the patieut, the greater the probability of complete closure.

Tait's modification.

Mr. Tait believes, and I think rightly, that if the muco-periosteum of the hard palate be elevated with a raspatory from the semilune of the palate bone, the tendinous attachment of the tensor palati will he raised with it, and thus paralysed, therehy doing away with the necessity of any such division of muscles as practised by Pollock or Fergusson, and diminishing the risk of the pin-hole orifice at the junctiou of the hard and soft palates. He advocates, moreover, two or more operations, viz. the hard palate to be first closed and the soft after some months' interval.

Fissures of the hard palate.

Fissures of hard palate.

These are to be treated ou similar principles to those of the soft, the great point of differeuce consisting in the separation of the soft parts with the periosteum from the bone. For this purpose, Langeubeck's

Operation.

instrument is the best—a kind of small hoe; with this, after making an incision down to the bone along the edge of the gum, he scrapes all the soft parts from the boue down to the free border of the fissure, the covering of the palate theu hanging as a free curtain. Care is

required in this proceeding not to tear or injure the soft parts, and more particularly the anterior and posterior portions where the vessels enter. The other steps of the operation are such as have been already described. Since November 22, 1873, however, Sir W. Fergusson has adopted with great success a method of dealing with fissures of the hard palate which was originally proposed by Dieffenbach in his 'Operative Surgery,' 1845. There is a want of evidence that the operation was ever previously performed, and Sir W. Fergusson was not aware even of the suggestion when he published his paper ('Brit. Med. Journ.,' April, 1874). The operation, as seen in Figs. 203 and 204, is as follows:

Fergusson's new operation.

Holes are first drilled with a curved brad-awl through the margins of the hard palate (Fig. 203, C) for the passage of the threads, while the

Fig. 203.

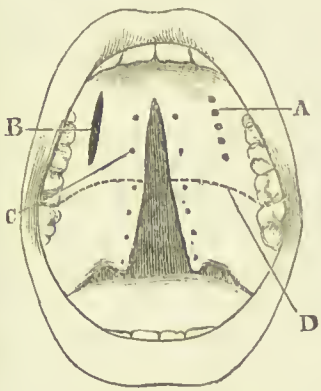
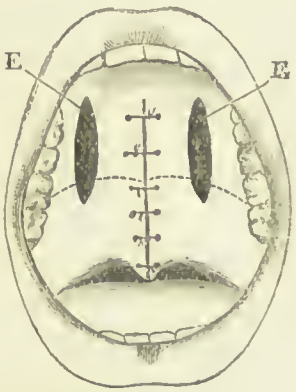


Fig. 204.



A. Preliminary punctures with awl to give line for chisel.
B. Incision through bone completed by chisel.
C. Holes bored through hard and soft palate for sutures.
D. Junction of hard and soft palate.
E. Lateral openings subsequently filled up by granulation.
These drawings were kindly made for me by Mr. W. Rose.

palate itself is then cut through with a chisel in a line parallel to and about half an inch from the edge of the cleft (Fig. 203, B), such a step being much facilitated by acting upon Mr. Mason's suggestion of previously drilling the bone with the curved brad-awl (Fig. 203, A). This loosening of the margins of the hard palate, allows the borders of the cleft to be brought together along its whole length, after the margins have been pared and the stitches twisted (Fig. 204). When any difficulty is experienced in approximating the loosened portions of the hard palate, the bones may be separated and prised down by means of the chisel, and the lateral openings plugged with lint. Indeed, if the bones are well loosened and the lateral openings well plugged, no sutures are required through the hard palate, the parts falling well together. The operation is very valuable, and in my hands has been successful.

When operative relief cannot be given in these cases or has failed, the patient must be handed over to an experienced dentist, for with a good obturator of gold or other material, great comfort can be given, and even a velum may be supplied of india rubber. On these points an article in 'Holmes's Surgery,' by my friend Mr. James Salter, may be

Use of metallic plate.

consulted with advantage. Operative relief, however, is always superior to instrumental, as in the latter the patient is entirely dependent upon the mechanist.

Wounds of the palate.

Wounds of the palate

are met with in practice from patients falling with pointed instruments in their mouths, such as pipes, sticks, spoons, &c. Small wounds need no attention, and generally do well; lacerated wounds dividing the velum, should be brought together by sutures; but where they have been left and a separation ensues, the edges may be subsequently pared and brought together as in fissured palate.

Perforation of hard palate.

Perforations of the hard palate

are generally due to the exfoliation of bone, and no plastic operation is of use. The proper treatment of such cases is to close the aperture by an accurately fitting plate of metal or vulcanite attached to the teeth, and arching immediately below the palate, but making no pressure upon the edges of the hole itself, as the effect of a plug is to enlarge the aperture by absorption.

Ulceration of palate.

Ulcerations of the hard and soft palates.

These are very common as a result of syphilis, and appear as *superficial ulcerations* about the pillars of the fauces and margins of the velum. They are often preceded by an erythematous redness and take on a sloughing action in cachectic subjects. They appear, too, also as *mucous patches* at any stage of syphilis, congenital or acquired, involving at the same time the tonsils, tongue, &c. They appear as slightly elevated spots covered with ashy or yellowish membranes beneath which some slight ulceration may be found. Frequently they are associated with other symptoms. They are to be treated as part of a constitutional disease, such local treatment being applied as the aspect of the surface may demand. Local astringents, as alum and borax, are, as a rule, of value, and also nitrate of silver or iodoform when local stimulants are needed.

Strumous ulceration.

Strumous ulceration of the palate.

This is a distressing affection, the ulcerative action being often so rapid as to destroy within a few days the whole fauces. It is chiefly met with in the young and feeble. In other instances, it is slower in its action though equally destructive, gradually eating away all the soft tissues even to the hard palate and pharynx, and is often mistaken for syphilitic disease, or *vice versâ*. The history of the case alone can determine the point. Tonics and local stimulants are, as a rule, the only requisite treatment; good food, of a liquid nutritious kind, being supplied in abundance. When gargles are difficult to use, carbolic acid lotion, Condy's fluid, or iodine lotion, a drachm of the tincture to a pint of water, may be scattered over the parts with the spray producer. In certain cases, a powerful local caustic such as nitric acid applied with a glass brush, tends to arrest the action. As a result of ulceration of the soft palate, it sometimes happens, that the palate becomes completely adherent to the posterior part of the pharynx. In one case under my observation, there was only an opening the size of a crow-quill between the pharynx and the nose, which I subsequently enlarged and kept dilated by means of tents with great advantage. In another, a central fissure existed, leading down to the œsophagus and upwards to the nose. In this case, the patient experienced great difficulty in deglutition. He had to eat with the greatest caution, otherwise the

Treatment of ulcers of palate.

Results of ulcération.

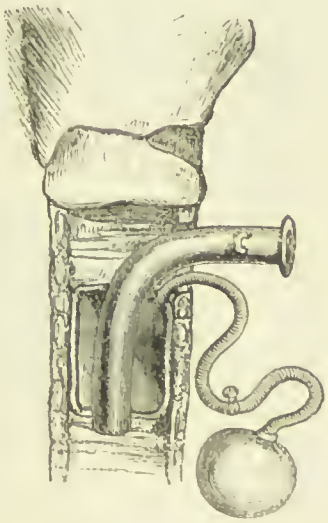
Adhesion of palate to pharynx.

food would pass into the larynx. Cases are on record in which it has been found necessary to enlarge this opening, and even to open the trachea to maintain life. Under such circumstances it is probably a wise maxim always to open the windpipe before any operative interference is undertaken in order to enlarge the pharyngeal opening.

Tumours of the palate or new growths are rarely seen. I have met with several cases of warty growths, simple and malignant, and in 'Guy's Reports,' 1869, I have recorded an interesting case of myxoma which covered the whole of the hard palate, and was cured by removal. Tumours of palate.

In August, 1872, I also removed from the soft palate of a man æt. 38, a globular fibrous tumour of six years' growth the size of an unshelled walnut, which had been for six weeks seriously interfering with deglutition and respiration. I enucleated the growth after making a free incision into its capsule, having previously been obliged to perform tracheotomy to prevent suffocation. In this case, I employed Dr. Trendelenburg's tracheal tampon (Fig. 205), and found it of great value. It effectually prevented the entry of blood into the air-passages, allowed the patient to be kept under the influence of chloroform, and enabled me to complete the operation with facility and safety. (*Vide* 'Med. Times and Gaz.,' May, 1872.)

Fig. 205.



Elongated uvula.

Section of trachea, with Dr. Trendelenburg's tracheal tampon.

The majority of cases of tumours that involve the palate, spread from the gums or upper jaw.

Elongation of the uvula from inflammatory œdema is sometimes a very acute affection. It comes on rapidly at times, and gives rise to suffocative symptoms. I have seen a case in which the uvula became as thick as a finger and rested on the tongue with its tip forwards, and of this, there is a drawing at Guy's. An incision into it, or several punctures, may give relief; but, as a rule, it is better to cut off the lower half of the organ. Elongation from other causes is far more common, and is generally to be recognised by the peculiar hacking cough and husky voice to which it gives rise, the end of the uvula acting as a constant irritant to the epiglottis or glottis. There is reason, indeed, to believe that not a few of the cases of supposed laryngeal irritation are due to this cause. The removal of the lower half of the organ by means of a long pair of forceps or scissors, rapidly gets rid of all the symptoms.

A polypus composed of simple mucous membrane may grow from the uvula. I have removed one from the tip, and another from the base. They give rise to symptoms identical with those of elongation. I had also a case under observation in which the polypus had so long a pedunele as to fall at times into the orifice of the larynx, and excite a violent spasmodic cough, but the man refused to have it removed. Polypus of uvula.

Tonsillitis.

Tonsillitis.

As an acute affection this is known as *quinsy* and is characterised by the rapid swelling of the part, acute pain, foul tongue, and fever. Within three days, or longer, suppuration may appear, and, when suffocative symptoms make their appearance, the surgeon's interference may be demanded. At times, life may be sacrificed by the want of surgical attention. Some years ago, a case came before my notice, where a child, two years of age, was suffocated from the bursting of a tonsillitic abscess.

Great redness and rapid swelling of the organs are the chief local symptoms.

Treatment of tonsillitis.

TREATMENT.—Fomentations externally, the inhalation of hot steam, and saline purgatives, are essential points of practice. As to drugs, none seem to have so powerful an influence over the disease as guaiacum, an ounce of the mixture with some compound spirits of ammonia being the best form, and when this is employed early, suppuration rarely appears. When an abscess has formed, the sooner it is opened the better. The best mode of doing this is to cover a straight bistoury to within an inch of its point with lint, and having depressed the tongue with the finger, to introduce it into the swollen tissue, making a free incision; care being taken not to direct the point of the knife outwards, but directly backwards. Should pus appear behind the pharynx, it must be let out. Tonics, such as quinine or iron, should then be given, with good food; a speedy convalescence as a rule ensues.

Chronic enlargement of tonsils.

Chronic enlargement of the tonsils.

This is frequently met with in feeble children as well as in adults living in marshy and damp localities. It is often a sequel of the more acute inflammation, but as often as not, it appears without any such cause. There is reason too to believe that some of the cases of so-called chronic enlargement of the tonsils are due to new adenoid tonsillitic growths. On two occasions when removing these enlarged organs, I have turned out distinct tumours the size of nuts embedded in and surrounded by tonsillitic tissue which were distinctly glandular, and, under the microscope, could not be distinguished from tonsil tissue. In both cases the enlargement was unilateral. Bilateral increase is probably always due to hypertrophy or chronic inflammatory enlargement.

Symptoms caused by enlarged tonsils.

This enlargement gives rise to a peculiar nasal twang in speaking and to a most distressing snoring, the patient as a rule having a half-opened mouth night and day. It is commonly associated with irritable mucous membranes generally. I have seen it so troublesome in a child three and a half years old as to prevent the deglutition of solid food, the patient having lived for six months on liquid nourishment.

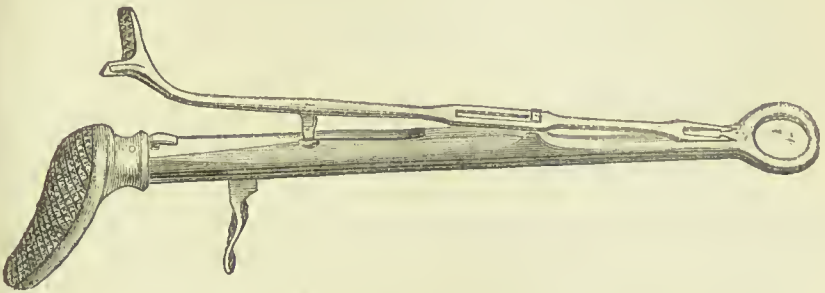
Treatment medical.

Tonic treatment is essential in all these cases; so is a *simple* nutritious diet. A mixture of bark and soda at first is the best to soothe and give tone to the digestive apparatus, cod-liver oil, quinine and iron, being subsequently prescribed. When the organs are congested from inflammation, the glycerine of tannin is a good application, and, when simply enlarged, a mixture of glycerine and tincture of the perchloride of iron, in equal parts, or Liq. Iodi, should be used. It is wise also to give the patient some solid iodine in a perforated box to stand on a shelf in the day as well as in the sleeping room; the gradual evaporation

of the iodine seeming to purify and iodize the air in a beneficial manner.

When the glands are white and hard, all hopes of curing them by medical treatment are at an end; excision is the only thing to do. For this purpose the guillotine (Fig. 206) is the best instrument to Removal of the tonsil.

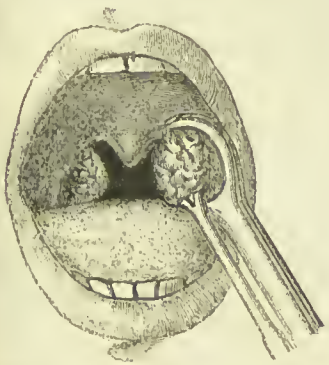
Fig. 206.



Guillotine prepared for use.

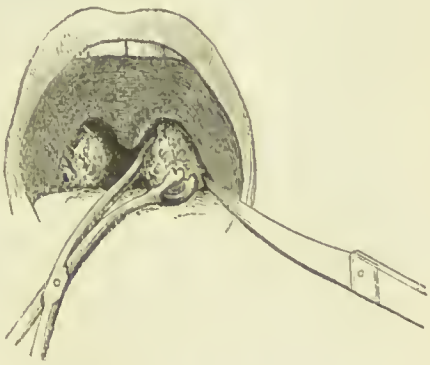
employ when it is at hand, otherwise a pair of vulsellum forceps and a bistoury must be used, guarding the base of the latter with lint or strapping to protect the lips (Fig. 208).

Fig. 207.



Operation on tonsil with guillotine.

Fig. 208.



Removal of tonsil with knife.

Calculus in the Tonsil.

In 1860, such a case came under my care. A man, æt. 38, after having suffered from enlargement of the right tonsil for a year and a half, expectorated a calculus the size of a nut, the expulsion of it having been preceded for three days by severe local pain and immediately beforehand the sensation of something having given way in the parts. When I saw him there was a distinct cavity in the tonsil. The stone was hard and ragged, and appeared to be made up of phosphatic salts; but the patient claimed the stone, and therefore it was not examined. Small calculi, the size of mustard seeds, are more common, and are supposed to be calcified tuberculous deposits. In Guy's Hosp. Mus. (Prep. 1677[50]) there is a specimen analysed by Dr. Babington which consisted of phosphate of lime. Calculus in the tonsil.

Cancer of the Tonsil.

Cancer of the tonsil.

This rapidly fatal affection happily is rare, and has not received much attention. It may appear as a primary or secondary affection, and in

Varieties.

the encephaloid or fibrous form. The *former* being the more frequent and rapid in its course, destroys life mechanically by secondary glandular enlargement, as well as by pharyngeal and laryngeal obstruction —the *latter* is seen mostly as an ulceration, and proves fatal by exhaustion. I have in one case seen this disease cause death by sudden and violent hæmorrhage owing to extension to and perforation of the internal carotid artery.

Characters.

This affection begins as an ordinary enlargement of the gland, but more rapid in its growth, and is mostly attended by early enlargement of the lymphatic glands at the angle of the jaw, and subsequently of those of the neck. When it ulcerates, the ulcer assumes the indurated jagged appearance of a cancerous sore, not unlike the deep syphilitic sore after the breaking down of a gummy tumour. It has, however, a more indurated base and border than the syphilitic. It attacks men mostly of middle age, but I have had under my care a sweep only seventeen years of age, with the hard form. I have the records of three other cases in males, aged respectively 49, 62, and 65.

Treatment palliative.

TREATMENT.—Palliative treatment is probably the best to adopt, although Dr. Cheever, of Boston, has proved that the tonsil may be successfully extirpated by external incision ('Boston Med. Surg. Journ.,' 1871). Its removal from within seems almost hopeless, whether by caustics—Maissonneuve's plan—the écraseur, or enucleation. I attempted the latter in one case only with partial success—and the operation prolonged life.

Cheever's mode of excision.

Dr. Cheever performed his operation through an incision made below the angle of the jaw of three and a half inches, along the anterior border of the sterno-mastoid muscle, with a second incision extending along the lower border of the jaw. The flaps were reflected and a large gland enucleated. The digastric, stylo-hyoid, and stylo-glossus muscles were cut—the fibres of the superior constrictor being divided upon a director. The pharynx was opened. The finger of the operator was then swept round the diseased tonsillitic mass which was enucleated. The hæmorrhage was free though not excessive, and twelve ligatures were applied. A steady convalescence followed. "The facilities," adds Dr. Cheever, "with which the tonsil can be enucleated with the finger is surprising." This operation may probably be justifiable and beneficial in those cases before the glands are too far involved. For further information on this subject, reference may be made to the article "Amygdales, No. 2," 'Dictionnaire de Médecine,' 1865, and to Poland's article, 'Brit. and Foreign Review,' April, 1872.

CHAPTER XIII.

DISEASES OF THE GUMS, JAWS, TEETH, PHARYNX AND ŒSOPHAGUS.

Epulis.

On Epulis. Varieties.

UNDER this term epulis are included, rightly or wrongly, most of the tumours of the gums—hypertrophic, polypoid, or diffused—simple outgrowths from the gums, due to the irritation of a carious tooth or stump, papillary, fibrous, fibroplastic, myeloid, epithelial, and cancerous tumours.

The true form.

The true or fibrous, fibroplastic, and myeloid epulis (for these elements enter in different proportions into all the benign forms of epulis) are diseases chiefly of the periosteum (Fig. 209), and are rarely

FIG. 209.

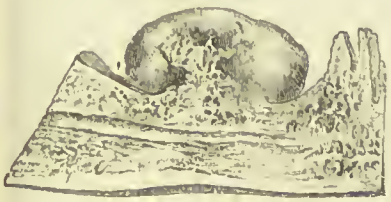


Fibrous epulis from gum. Drawing, Guy's Hosp. Mus., 271[10]. Mr. Birkett's case.

cured without removal. At times, however, they invade the bone (Fig. 210), the endosteal membrane which lines the bone being continuous with the periosteal covering it. They may appear as simple fleshy outgrowths of the gum about a tooth, and develope into a large mass of a firm or semi-elastic tissue. At a later stage, this mass may ulcerate and break down.

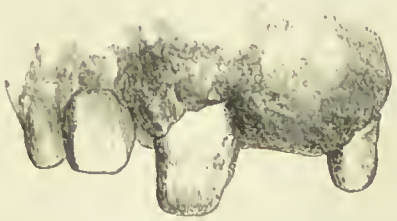
Characters.

FIG. 210.



Epulis springing from bone. Mr. Key's case.

FIG. 211.



Front view of tumour of alveolus. Due to hypertrophy and dilatation of tooth fang.

Case of odontome of upper incisor tooth.

In exceptional cases, a tumour that appears to be an epulis, results from the abnormal development of a tooth; this was the case in a boy, æt. 11, from which Fig. 211 was taken, the expansion of the alveolus having arisen owing to the development of an odontome of

the root fang of an upper incisor tooth which had been growing for three or four years.

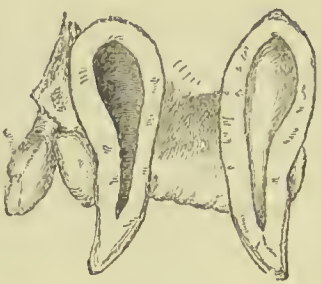
Fig. 211 illustrates the swelling of the gum before the removal of the disease; and Fig. 213, a section of the odontome. My friends, Messrs. Salter and Moon, informed me that this is a unique case. In the diagnosis of such a case, the protrusion of the crown of the tooth becomes a valuable guide.

Fig. 212.



Odontome after removal.

Fig. 213.



Section of odontome, showing expanded thickened root of incisor tooth.

Mode of removal.

TREATMENT.—The removal of the disease, of the teeth or stumps that are involved in it as well as of the bones with which it is connected, is the only sound practice to adopt. A good pair of cutting pliers, which will nip off as much of the alveolar process as seems involved, is the best instrument to use, a small hand saw having marked out vertically the limit of the incision. When the bone is not removed, a return of the disease is almost certain.

Cancerous

A *cancerous* disease of the gums puts on precisely similar appearances to those seen in similar diseases of the fauces, face, or tongue —an irregular, excavated, ulcerating surface, discharging fœtid pus, associated with pain, and glandular enlargement marking its true nature. Most of the cases of cancerous epulis are epithelial. The benign form of epulis is generally an affection of young life, and the cancerous of the old and middle-aged.

Polypus.

Polypus of the gum or outgrowths of gum structure, are due to the irritation of carious teeth or to uncleanly habits. They can be cured by the removal of the growth and its cause.

Vascular tumours.

Vascular tumours are met with on the gums and generally found between the front teeth. They are sometimes but not always associated with carious teeth. The outgrowth is usually small and more or less pedunculated, bleeding on the slightest manipulation. The vascular tumour occasionally presents more the features of a nævus. I have destroyed many of these growths by means of the galvanic cautery with success, but they can be removed by the knife or any caustic. When a carious tooth appears to be the cause of the disease it should be at once removed.

Abscess about gums.

Abscesses about the gums are very common, and are frequently the result of disease of the teeth. Dentists tell us, however, that these gum-boils rarely induce any disease of the bone, though they sometimes arise from it. When connected with a carious tooth, and are of long standing, nothing but the removal of the tooth will effect a

cure. When associated with disease such as "necrosis" or death of the bone, the removal of the dead portion is an absolute necessity.

Necrosis of the Jaws.

Exanthematous necrosis.

This is a common affection as a consequence of one of the exanthemata, or some other fever, and is now fairly recognised. It is more common in children than in adults. As a rule it appears on the decline of the fever, with pain and swelling about some portion of the gums, and rapidly passes on to suppuration and death of the bone. The necrosis, however, is generally confined to the alveolus, in exceptional instances only it involves the body of the bone. Both jaws are equally liable to the affection. In the 'Guy's Hosp. Reports' for 1869 I recorded a series of cases to illustrate these points. In one case, narrated in detail, that of a woman, æt. 25, who in infancy had lost a large portion of her upper jaw after measles—the lower jaw had grown up to fill in the deficiency in the upper. It was nearly one inch higher in its vertical measurement on the right side than the left; it seemed, indeed, as if the lower jaw had grown upwards for want of the regulating influence of the natural pressure which the teeth of the upper jaw must exert upon those of the lower when in contact with them. I have recently seen a similar case where the increase of growth had taken place in the upper jaw, in consequence of a deficiency in the lower.

Compensatory growth of jaw after necrosis.

Phosphorus necrosis.

Necrosis of the jaws, as a result of the phosphorus poison, is now rarely seen, in consequence of the common phosphorus being less frequently employed than formerly in the making of lucifer matches. Dr. Bristowe, in his report to the Privy Council in 1863, clearly showed that it is to its influence the disease is to be attributed, *the amorphous phosphorus* being harmless. The first notice of the affection in this country was by my colleague Dr. Wilks, in the 'Guy's Hosp. Rep.,' 1847, page 163. The disease is acute in every sense. It may involve a part only, or, the whole of the upper or lower jaw, both seeming to be equally liable to the affection; but in the majority of cases, the teeth of the affected bone are more or less diseased or deficient. It is a rare thing to find the disease in subjects who have sound teeth, or in those who have a complete set. Some openings down to the bone either through carious or deficient teeth, appear to be necessary to enable the phosphorus fumes to act upon the bone. Dr. J. Ward, of New York, records a case in which the whole bone died and was restored.

Symptoms.

Progress of disease.

The disease begins for the most part by a general aching of the teeth, followed by rapid suppuration and necrosis of the affected bone. The constitutional are usually as severe as the local symptoms.

Necrosis may also take place independently of any of the causes already alluded to and may follow as a result of fracture, but its true cause is generally difficult to ascertain. It is found in both upper and lower jaws. An analysis of fifty consecutive cases shows, that nineteen were in the upper, twenty-nine in the lower, and two in both, thus controverting the assertion of Stanley which has been repeated by others, that necrosis of the upper jaw is rare. It may show itself at any period of life. I have seen it in an infant a fortnight old, although it is more common in the young and middle-aged than in the aged. It may attack any portion of the bones, and even the condyloid processes of the lower

Statistics of necrosis of jaw.

Period of life.

Part attacked.

jaw may die and be removed, leaving a movable jaw by the spontaneous formation of a new joint. The child, æt. 8, from whom I removed the bone, illustrated below (Fig. 214), could move the jaw as well as if the condyle had never been destroyed, and, in 'Guy's Hosp. Rep.' for 1869, I recorded another similar case.

Is preceded by inflammation.

Necrosis of a bone is always preceded by symptoms of inflammation such as swelling and pain, followed rapidly by suppuration, and the formation of sinuses leading down to the bone, which may be felt by a probe. A single sinus below the jaw or in the neighbourhood may be due to the presence of a diseased tooth.

Fig. 214.



Portion of lower jaw removed for necrosis from a child æt. 8, the movements of the jaw subsequently being perfectly regained.

Treatment of necrosis.

Treatment.—When dead bone can be detected, either in the upper or lower jaw, there is only one form of practice which ought to be entertained, and that is removal. It should be removed, too, with as little disturbance as possible to the soft parts, or to the new bone-forming tissues such as the periosteum, and by the mouth. When this latter practice is impossible or impolitic from any cause, the surgeon should take every care that his external incisions are made where afterwards they will be little seen.

Of upper jaw.

Of lower jaw.

In necrosis of the *upper* jaw, the bone can nearly always be removed by means of incisions made *beneath* the cheek. An incision *through* the cheek never seems necessary. In necrosis of the *lower* jaw when incisions through the integument are demanded, they should be made below its lower border. When the dead bone is fixed, or rather before it has been thrown off from its attachments and before a new casing of bone has been formed, all operative interference must be condemned, particularly in the lower jaw, as there seems little room to doubt, that the muscles, acting upon the new bone before it has become consolidated, may alter its shape and produce deformity. Under these circumstances, the surgeon should content himself with seeing that all pent-up pus has free exit, by means of incisions through the gum, also that the patient's mouth is kept as clean as possible by frequent washing, and that his general condition is maintained by means of tonic medicine and nutritious diet. When the necrosis is confined to the alveolus in which the temporary teeth are situated, great care should be taken that the parts beneath are not disturbed, and that the permanent teeth are not interfered with. Even when exposed these permanent teeth need not of necessity be removed. In young patients where much loss of bone has taken place, it seems desirable to have some artificial substitute, in order to prevent the occurrence of such an over-

When confined to the alveolus.

growth of the opposing jaw as took place in the cases already referred to. Where the antrum is exposed by exfoliation, much may be done by the dentist to fill in the gap. A few years ago, Mr. Salter very skilfully adapted a plate with teeth to the upper jaw of a woman in whom the anterior wall of the antrum, with part of the alveolar process, had exfoliated. At times also, the fistulous opening takes place externally; thus, in 1864, I was called on to treat a woman, æt. 34, who nine years previously had had extensive necrosis of the upper jaw, and, as a consequence, a fistulous opening the size of a sixpence was left below the right eye, communicating directly with the antrum. The soft parts were firmly connected with its margins, and the lower lid drawn down. I raised the integument from the bone, making free subcutaneous incisions, pared the edges of the flaps, and brought them together over the opening in the bone. Good union followed and the deformity was removed.

Where antrum exposed.

Where fistulous openings remain.

Tumours of the Jaws.

Some of the most remarkable tumours of these bones are due to hypertrophy or hyperostosis—the lower jaw with other bones of the face and head being generally involved. Mr. Howship's well-known case of disease of the upper jaw, which is noticed everywhere, is a case in point; so is that of Mr. Bickersteth's, which was exhibited at the Pathological Society in 1866, and which he described with all minuteness in the 'Transactions' of the year. The disease is usually symmetrical, showing itself as a uniform enlargement of the bones involved—the upper jaws projecting as two large globular masses.

Tumours of the jaw.

Hypertrophy.

Cystic disease of the antrum.

This is a special affection and often connected with irregular dentition; though how often has not yet been determined.

Diseases of antrum.

Suppuration of the cavity is often due, doubtless, to an extension of inflammation from the teeth and may arise from a blow or some other cause. It is known by severe local pain, extending over the face and forehead, local swelling, and extreme tenderness, the constitutional symptoms being often very severe. When pus has formed there may be rigors, and the abscess may burst either into the nose or into the mouth beneath the cheek—the antrum, under these circumstances, becoming much distended. In rare cases it may make its way through the cheek, and in one where this occurred, an opening into the antrum the size of a fourpenny piece was subsequently found, on making an incision down in the bone beneath the cheek. In neglected instances, the floor of the orbit may be displaced and vision interfered with or even destroyed. (*Vide* Salter, 'Med.-Chir. Trans.,' 1863.)

Suppuration of cavity.

Treatment.—When suppuration has been made out, the antrum should be opened, and if its anterior wall be expanded, an opening may also be made into it without fear at the most projecting point with a trocar or other sharp instrument. The relief given by these means is very signal. In one case of a lady that came under my care some years ago, it was instantaneous and permanent. When diseased teeth are present in the bone, they should all be tested by a sharp blow, and the most tender removed. A jet of ether spray on each tooth will prove an admirable test, the cold searching out the slightest disease. It is never advisable to remove sound teeth unless some evidence exists of their alveoli being diseased. In all these cases the cavity must be kept clean by syringing. A chronic abscess in the

Treatment of suppuration of antrum.

autrum may be so insidious in its formation as to induce the surgeon to believe that a tumour exists. Liston gives an instance in his 'Practical Surgery' of such an error, in which removal of the jaw was attempted. In all tumours of the upper jaw, the probability of the presence of a large cyst should never be forgotten.

Hydrops antri.

Hydrops antri is now a well-recognised affection, and is characterised by a gradual, painless expansion of the bone, rarely producing other symptoms than those due to mechanical pressure. It encroaches on the nose, and causes obstruction; on the orbit, and presses on the globe; on the mouth, and produces bulging of the palate; and, on the cheek, so as to cause deformity; indeed, it is often because of this that the patient is induced to seek advice. When the expansion is great, the shell of bone may become so thin as to crackle like parchment under pressure. This sensation may be yielded by pressure upon its external or palatal surface. M. Giraldès, in 1853 (Montyon prize), was the first to describe these cysts with clearness, although Mr. W. Adams had previously recognised them. (*Vide* 'St. Thomas's Hospital Museum Catalogue.') The old surgeons looked upon this affection as the result of obstruction to the aperture between the nostril and antrum, the dilatation of the bone being due to retained mucus, but this is now known to be an error. All recent pathology tends to indicate, that it is a cystic disease of the mucous lining of the antrum, the affection showing itself as a single cyst, or, as a cystic degeneration of this tissue. Giraldès regards these cysts as dilatations of the glandular follicles of the mucous membrane. The fluid contents of these cysts are always viscid, occasionally clear, but mostly blood-stained, sometimes purulent, containing cholesterine, but never pure mucus. I have recently, however, had a case in a boy æt. 16, with Mr. R. Phillips, of Leinster Square, where the fluid was serous and blood-stained in a high degree.

Dentigerous cysts.

Dentigerous cysts are, clinically, closely allied to those just described; pathologically they may differ; but there can be no doubt that the cysts are connected with the teeth, which are in some cases fully developed, and in others imperfectly so. They are found in both upper and lower jaws. Heath, in his excellent 'Essay on the Jaws,' 1868, informs us that cysts of small size, in connection with the fangs of permanent teeth, are frequently found on extracting the latter, but give rise to no symptoms demanding surgical interference. Occasionally growing to a large size they produce absorption of the containing alveolus, and give rise to a prominent swelling. The disease is generally slow in its progress, and tolerably painless; by its pressure the cyst may cause absorption of the bone with which it is in contact, and a deep excavation. Paget relates in his 'Surgical Pathology' such a case as a cyst near the gums, and I have had under observation a woman who had a tumour in her left cheek for years, which when opened, discharged some watery fluid. She applied to me for a bony projection of the cheek, that was clearly the edge of the alveolar process of the upper jaw, the bone above having become absorbed by the pressure of the cyst, thus causing a cup-like depression. She had had all her teeth removed at different times by dentists, under the impression that the disease was due to them.

Symptoms and progress.

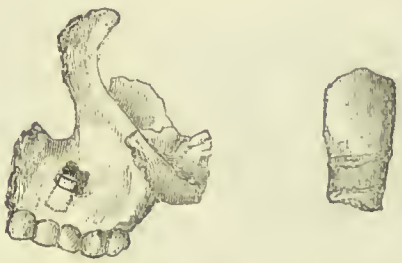
Cysts connected with undeveloped teeth.

The *dentigerous cysts* are found in both jaws, and are almost always connected with the permanent teeth, rare cases being recorded in which the temporary were implicated. In this affection, the teeth

fail in development and remain within the jaw, the tooth, acting as a foreign body, setting up irritation, and causing the cystic affection I am now considering, or some solid growth. Thus in a boy æt. 6, who came under my care some years ago, a cystic enlargement of the jaw of three years' development existed. It encroached on the orbit, mouth, and cheek. I made an opening into the anterior wall of the cyst, making a window in the bone, and, through this, an incisor tooth was seen with its crown upwards (Fig. 215). The tooth was removed and a good recovery ensued. In January, 1872, I treated a similar case in a girl, æt. 17, sent to me by Mr. Salter, who had had her under observation for two years. The disease was in the right upper jaw, and the right canine tooth was deficient. I exposed the cavity and removed the tooth (which was growing in an abnormal direction upwards and inwards), a good recovery taking place. I saw my colleague Mr. Poland open one in the lower jaw, and remove a tooth with success. On July 24, 1875, I trephined a tumour of three or four years' growth of the lower jaw of Miss R—, æt. 30, a patient of Mr. R. Moon's, of Norwood, and also of Mr. Salter's, and removed from it a canine tooth which was resting obliquely in the cavity (Fig. 216). Mr. Salter has collected many similar cases. It is well to remember, that these dentigerous cysts like other cysts of the jaws, may simulate solid tumours. When they occur in the lower jaw and expand the bone, this error is very likely to take place. In all tumours of the jaws that have a smooth or cystic outline it is well, therefore, to make an exploratory puncture for the purpose of diagnosis. When the walls crackle from the thinness of the expanded cavity, the diagnosis is simple.

Examples.

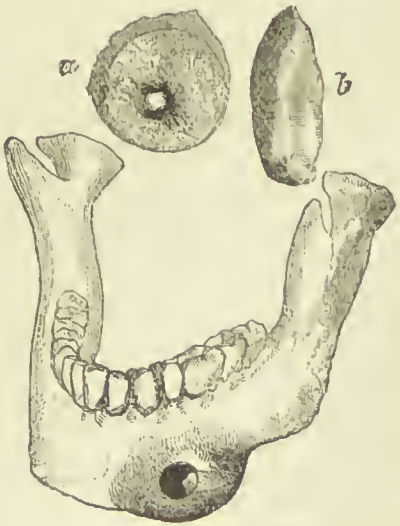
Fig. 215.



Tooth as seen through opening in upper jaw.

Natural size of tooth when removed.

Fig. 216.



Canine tooth as seen in case of Miss R—, in expanded lower jaw with tooth (*b*) of its natural size. *a*. Bone removed by the trephine.

Treatment of dentigerous cysts.

Treatment.—The free opening of the cyst is the one essential point of practice to observe in all these cystic diseases of the jaws, upper or lower, with the extraction of any tooth that may be present in the

eyst. This can be done with a knife or a sharp pair of forceps, after a perforating wound has been made by a trephine, drill, gouge, or pointed instrument. To induce suppuration of the cyst, it is a good practice to plug the cavity with lint. When the cavity is large, it is wise to take away a considerable portion of its wall. Removal of a segment of bone for cystic disease is rarely needed. Before, however, the pathology was understood this malpractice was often perpetrated, as our different museums too truly testify.

Dentigerous tumours.

Dentigerous tumours may likewise occur. In Fig. 217 is illustrated a case, in which I removed the upper jaw of a child, æt. 8, for a nearly solid myeloid tumour of the jaw clearly originating in a malplaced tooth which was growing from the posterior part of the orbital plate of the bone; one or two cysts existed in the growth enough to allow of its being called cystic. There was no possibility of making a diagnosis in this instance; such examples are very rare.

Fig. 217



Dentigerous tumour of jaw.

Tumours of the jaws.

These are of different kinds, simple and malignant, connected and unconnected with teeth. When in the antrum, their dental origin should be suspected, but in both upper and lower jaws, solid tumours of all kinds have been found with teeth as their centres.

Polypi of the antrum.

Polypi of the antrum—as are those of the nose—are occasionally met with, and they show themselves mostly as projections into and through the nostril, the tumour making its way through the nasal wall of the antrum, and, at the same time, generally expanding its facial wall. I

Examples.

have seen four well-marked cases of this sort, and in two the whole mass was removed through the nostril, which was laid open, and turned back. In the third, the cheek was reflected outwards at the same time, and a large opening made into the antrum allowing the surgeon to scoop out the growth. Two of these cases occurred in the practice of Mr. Cock, and two in my own.

Tumours of the upper jaw.

Tumours of the upper jaw.—Weber, quoted by Heath, informs us, that in an analysis of 307 cases of tumours of the upper jaw, more than one third of the whole number may be set down as

Varieties.

sarcomatous simple tumours, one third as osseous, and less than one third cancerous, the myeloid being included in one of these groups. They may grow also from any part of the bone or periosteum. When they originate in the antrum they expand its cavity, as is the case in the cystic disease, and cause a bulging of one or more of its walls. When they spring from a surface or plate, the tumour will

The fibrous.

project from it, leaving the other surfaces unaffected. The fibrous in all its forms and the osseous are usually of slow growth. They are

The fibro-plastic.

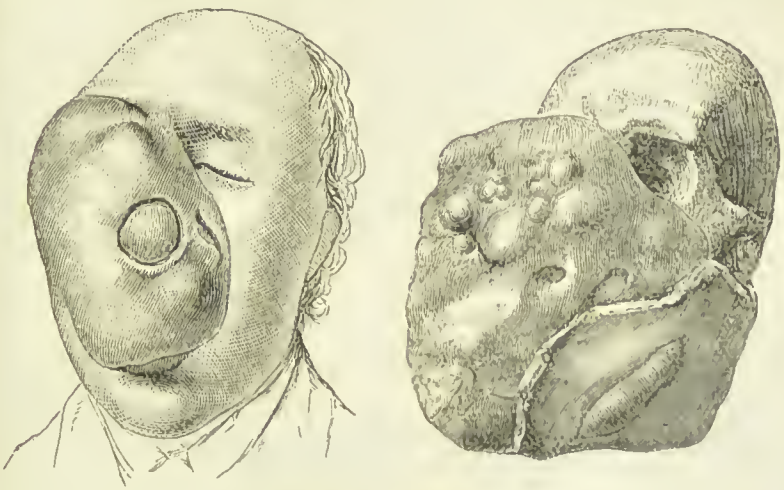
often painless, and trouble only from their size. The fibro-plastic, myeloid, and cancerous are of more rapid growth. The fibrous or fibro-plastic are usually periosteal growths, the osseous, myeloid, and

The cartilaginous.

cancerous endosteal. The cartilaginous are very variable in their progress, now very slow and then rapid. They are chiefly of the mixed kind, fibre tissue largely predominating in tumours of slow

formation. They frequently involve many bones. Sir J. Paget ('Surgical Path.') states, that in the only case on record of euchondroma of the upper jaw alone, the disease was removed by Mr. Morgan—late of Guy's—from a man æt. 24; the tumour was of the right maxilla and was of nine years' growth. The patient survived the operation seven years. Figs. 218 and 219 illustrate the case; the first being taken before

Fig. 218. Fig. 219.



Enchondroma of upper jaw.
Before operation. Model, Guy's Hosp. Mus., 38^{10}. After death. Model, Guy's Hosp. Mus., 38^{12}.

Mr. Morgan's operation and the second after the patient's death. Dr. Heyfelder, of Munich, says, however, that he found eight such cases out of 450 of disease of the upper jaw.

Treatment of tumours of upper jaw.

Treatment.—All solid tumours of the upper jaw must be extirpated, but not more of the bone should be removed than is necessary. Sir W. Fergusson established this rule in practice, and it is one that all surgeons should strive to follow. Thus, when the disease springs and projects from the facial surface of the bone, the tumour, with the facial plate alone, requires excision. When the alveolar process is alone implicated, the other portions of the bone must not be touched. Where possible, the palate plate should be preserved, and it is bad surgery to interfere with the orbital plate without an absolute necessity. When the whole bone is involved in the disease, it must be removed, but such cases are exceptional. In many cases where the disease originates in the antrum, a partial removal of the bone will suffice, if the surgeon can at first only lay open the cavity and find out the base of the growth. For perforating the antrum with a view to exploration Sir W. Fergusson recommends an ordinary carpenter's gimlet.

Excision of part or whole of upper jaw.

Operation for the removal of part or the whole of the upper jaw.—The incision now almost universally adopted for the removal of tumours from the upper jaw is the one of Sir W. Fergusson (Fig. 220); as by it all the necessary room is given to remove even the largest growth. The facial nerve and artery are divided, where by their size, they are of small consequence, and the scars are so placed as to become almost imperce-

Description of the operation.

Different incisions.

tible. In tumours of *moderate* size, the incision should be carried through the median line of the lip into the nostril, when, by raising the nostril and retracting the cheek outwards, abundant room is obtained. When more room is required, the operator may extend his incision round the ala and up the side of the nose towards the inner canthus, and if this is still insufficient, a third incision may be made from the termination of the second along the lower border of the orbit.

These incisions are indicated in Fig. 220, which was taken from a man æt. 35, from whom I removed an osteochondroma, of twelve years' duration, involving the facial and palate plates of the superior maxilla. The dark line indicates the incision made; the dotted extra line that which may be required in exceptional instances. Fig. 221 illustrates Gensoul's and Liston's method.

Fig. 220.



Fergusson's incision for removal of upper jaw.

Fig. 221.



The dotted line, *a*, Gensoul's incision; *b*, Lizar's and Liston's.

In some cases, the ala of the nose alone may be turned up. I removed a fibrous tumour growing from the nasal process of the superior maxilla by this incision, and found ample room. The incision having been made, and integument reflected sufficiently to expose the tumour, all bleeding should be stopped by ligature or torsion. Assuming that the whole bone has to be removed, the incisor tooth of the affected side must be extracted, and the palate plate of the upper jaw with the alveolus divided with a fine saw (Fig. 222) introduced into the nostril. The malar process of the maxillary bone is then to be partially sawn through, as well as the nasal process of the superior maxilla, their complete section being made with bone forceps. The tumour should then be seized, the Lion forceps (Fig. 223) being employed, and the whole wrenched off, bone forceps and scissors being employed to complete any section that may be required. The infra-orbital nerve should be divided with scissors, and the soft palate left as little injured as possible. If any portions of the disease be left they can now be removed.

Fig. 222.

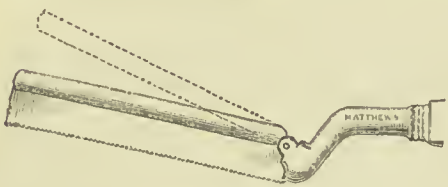


Fig. 223.



Lion forceps.

All bleeding vessels are to be treated by ligature, torsion, actual cautery, or styptics, and the parts carefully brought together with interrupted sutures.

When the disease, says Heath, is of less amount and the orbital plate not involved, this should be preserved by carrying a saw horizontally *below* it; and if the palate be not involved, this may be advantageously kept intact by making a similar cut immediately *above* it. Sir W. Fergusson advises that the disease should be cleared out from the centre towards the circumference, so as not to remove healthy structures unnecessarily, and this may be readily accomplished by means of the many forms of curved bone forceps with which surgeons are now familiar, aided by the gouge.

Practical hints.

In a case of myeloid disease of the upper jaw involving the whole of the hard palate, I peeled off all the soft parts from the bone, beginning at the alveolus, and, having removed the diseased bone, brought them up again in position and fixed them to the mucous membrane of the cheek where it had been separated from the bone. By this means I preserved the roof of the mouth from the first, and, what is more, eventually obtained an excellent new palate. The practice is probably worth attempting.

FIG. 224.



Periosteal sarcoma of lower jaw.

View of section. External aspect of tumour.

Tumours of the lower jaw grow to enormous dimensions, and pathologically are very similar to those of the upper. The fibrous in one of its forms is probably the most common, the periosteal tumour being more frequent than the endosteal. The latter may occupy the dental canal as illustrated by a case of Mr. Cock's (Guy's Hosp. Mus., 1091[25]), in which the dental nerve passed through the tumour. The periosteal growth is often an epulis, and a good example of this form is represented in Fig. 209. But a more typical example of a true periosteal sarcoma which I removed in 1872, from a girl æt. 20, is illustrated in Fig. 224. The tumour was of three months' growth. It returned three months after removal, and destroyed life by suffocation, having grown to the size of the patient's head. Microscopically the tumour was a

Tumours of the lower jaw.

Varieties.

FIG. 225.



Fibro-cellular tumour of the lower jaw. Mr. Heath's case.

spindle-cell periosteal sarcoma. One of the largest fibro-cellular tumours of the bone on record occurred in Mr. Heath's practice, and is illustrated, with his permission, in Fig. 225. It was removed from a man æt. 32, and the disease was of eleven years' growth. It weighed 4 lb. 6 oz.; the man died from exhaustion on the sixth day.

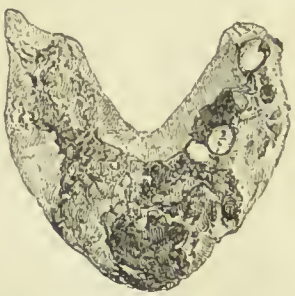
Fibro-cystic tumours.

Fibro-cystic tumours of the lower jaw are very common, and have the same clinical history and aspect as the cystic tumours to which attention has been already directed. The most beautiful example on record is that which was removed by the late Dr. Hutton of the Richmond Hospital, Dublin, and is illustrated in Heath's book; it was made up of cysts of nine years' growth, and in a young woman only 20. A yet more remarkable case was operated upon by Mr. Key in 1841, in a boy æt. 13 (Figs. 226, 227). The tumour was of two years' growth and painless. Mr. Key removed the whole by sawing through the lower jaw just below the angle on each side, and a good recovery ensued.

Fig. 226.



Fig. 227.



Fibro-cystic disease of lower jaw.

Guy's Hosp. Mus., Drawing 4[57]. Key's case, during life.

Guy's Hosp. Mus., 1090[50]. Key's case Tumour after removal.

Cartilaginous growths.

Cartilaginous growths are uncommon, and occur in early life, and as already stated are periosteal and endosteal. A fine example of the latter can be seen in 'Prep. 1091[15] and [16], Guy's Hosp. Mus., which Mr. Key removed in 1846, from a woman æt. 29, in whom the disease had been coming on for nine years. In the preparation, the fibro-cartilaginous substance is seen to be placed between the plates of bone of the jaw, the teeth being in the middle of the new growth. The periosteal tumour grows to a large size.

Osseous tumours.

Osseous tumours are sometimes the result of ossified enchondroma. There is in St. Thomas's Museum a specimen of this kind which was removed by Mr. Cline. Bone may, however, occur as an independent growth in the form of cancellated or ivory exostosis, which may sometimes grow to a large size or cause other troubles; hence, in March, 1877, I had to remove a portion of the lower jaw from a lady, æt. 50, who had had an exostosis growing for twenty years from its inner surface at a point corresponding to the right bicuspid and canine teeth. The growth had not given rise to any trouble till the soft parts covering its apex had begun to ulcerate, when, from its roughened surface, the bone so irritated the floor of the mouth as to set up ulceration which was thought to be cancerous. I removed the exostosis with the bone and then reached the supposed cancer, which I isolated by needles

passed through the base of the growth, and removed by means of the galvanic écraseur. A good result followed.

Cancerous tumours

Cancerous tumours are usually endosteal, and numerous are the cases on record of the affection. They are met with in children and adults, and rarely are of the hard kind of cancer. They grow rapidly but soon break down, involving skin and all adjacent parts in the disease; indeed, any rapid growth about the lower or the upper jaw should be suspected as being cancerous. Almost all benign tumours are of slow growth.

Treatment of tumours of lower jaw.

TREATMENT.—Tumours of the lower jaw as of the upper are to be treated by excision, which as a large operation is most successful. I have on eighteen occasions removed large portions of the jaws with but one death and that was from inflammation of the lungs. Heath says that Mr. Cusack removed large portions in seven cases with only one fatal result, and Dupuytren operated in twenty with only one death. Sir. W. Fergusson also informs us that his success has been very great, and Syme and Liston's success is well known.

When small.

Small tumours of the jaw, and particularly of the alveolus, may be removed from the mouth with good cutting forceps. If more room be required to manipulate in the month, an incision may be made outwards or downwards at the angle. On several occasions I have obtained all the room I required by making a horizontal incision below the level of the jaw and a dissection of the soft parts off the bone.

Mr. Maunder has shown that large portions of the lower jaw the seat of tumour may be taken away without external incision after detaching periosteum by means of the raspatory.

When large.

When a large tumour has to be removed, it may readily be exposed by a curved incision carried along the posterior surface of the tumour from above the angle of the jaw to the median line turning the soft parts back. In doing this, the facial artery will be divided, and it should be at once secured at both ends by torsion; the knife, says Fergusson, being so lightly carried over the artery that it need not be divided till the flap is being raised, thus saving blood. The labial orifice rarely need be divided, and the incision should be stopped short of this margin. The tumour having been exposed, its surface must be well examined with the view of the removal of the growth by cutting away the external plate of bone which covers it in, which can be done by means of the gouge and bone forceps. This step may be looked upon as wise under most circumstances, especially in doubtful cases, as a large number of tumours of the jaw, particularly the cysts, may be scooped out, and recovery ensue. If the tumour and jaw require excision a tooth must be extracted in front where the bone is to be divided and a small saw applied; the bone should then be grasped with the Lion forceps and drawn outwards—the surgeon carefully dividing all the soft parts that hold it in position on its inner surface, keeping the knife *close to the bone*. When the disease stops at the angle the saw and forceps are again to be applied and the tumour removed. Where disarticulation is required on account of the extension of the disease, the jaw must be forcibly depressed so as to bring the coronoid process within reach, and allow of the division of the insertion of the temporal muscle. The condyle may then be twisted out, the knife dividing cautiously such ligamentous fibres as are put on the stretch. Fergusson says that in doing this, he has found the condyle actually separated from the periosteum on its inner side, thus facilitating its removal, and in two cases of my own,

Operation of excision.

When disarticulation required.

I found this to occur in one after the division of the periosteum with the knife. When the tumour is so large as to be wedged in and prevent this mode of dislocation, the best plan is to re-apply the saw and cut off the tumour as high as may be, and subsequently, to remove the remaining portion of jaw. When the central portion of the lower jaw is removed, there is danger of the tongue falling back, and causing suffocation; to prevent this a ligature may be passed through the tip of the tongue and held during the operation and on the completion of the operation it should be fastened to the wound. The ligature should be removed on the second or third day.

When central portion removed.

After the operation, all arterial bleeding should be stopped, a stream of cold water over the parts arresting any oozing, while the edges of the wound are to be brought together by interrupted sutures. Convalescence is generally rapid and recovery complete; the deformity following being so slight as not to be observed in many cases, the interval being filled with dense fibre tissue. Bone is never re-produced, but the tissues soon become firm enough to bear the support of artificial teeth.

The half-sitting position is probably the best in all these operations on the jaws; and chloroform may be given without fear. For more details connected with this subject the student may refer to Heath's admirable 'Monograph on the Jaws;' Fergusson's 'Surgery;' Liston's paper, 'Med.-Chir. Trans.,' vol. xx, and his 'Pract. Surgery.'

Disease of the articulation.

Disease of the temporo-maxillary articulation is rarely met with, more rarely indeed than disease of any joint in the body. I have seen only two examples of it, one in a woman, æt. 34, who had had it for nine years, suppuration having existed for six; several sinuses leading down to the joint were present, and the jaw was nearly fixed; dead bone appeared to be present; the patient refused to have any surgical interference. The second case was a girl æt. 18, in whom both sides of the lower jaw were completely anchylosed. In Guy's Hosp. Museum there is also a splendid specimen, No. 1070, of complete synostosis of the articulation.

The cases already quoted of necrosis of the condyloid process of the lower jaw, and recovery with a sound joint, may here be referred to.

Closure of jaws.

Causes.

Closure of the jaws may be caused by some spasmodic condition of the muscles of the jaw secondary to disease of the teeth, or the cutting of the wisdom teeth. In the latter the mouth must be forced open under chloroform, by means of the screw gag or wedges, and the tooth removed, or, what is better, room made for it to come forward by the extraction of a neighbouring molar. It may likewise be caused as indicated above by anchylosis, or by the contraction of cicatrices either within or without the mouth. In February, 1878, I operated upon a woman, æt. 43, who for 37 years had had her jaws locked from adhesions between the cheeks and gums. She had lived on liquid food for the whole of this period. I divided the cicatrices and opened the jaws with a promise of a good recovery. The condition had followed scarlet fever. Dr. S. Gross, in his 'System of Surgery,' informs us that the latter causes are the most common, and he attributes the majority to the evil practice of giving calomel to salivation. In rarer cases the immobility is occasioned by an osseous bridge extending from the lower jaw to the temporal bone, this condition being generally associated with chronic articular arthritis. "However induced," writes Gross, "the effect is not only inconvenient, seriously interfering with mastication and articulation, but it is often followed, especially if it occur early in life, by a

stunted development of the jaw, exhibiting itself in marked shortening of the chin, and in an oblique direction of the front teeth."

Treatment of closure of jaws.

TREATMENT.—Where the cause is in the joint and cannot be removed, as can dead bone, the surgeon may attempt to break up the adhesions by forcibly opening the mouth under chloroform, or divide the bone below the joint. When due to cicatrices and nodular plastic matter, little good has ever been derived from their division although in the case previously alluded to the prospects of a good result are satisfactory. Esmarch, of Kiel, in a paper 'On the Treatment of Closure of the Jaws from Cicatrices,' 1860, has, however, described an operation for the formation of a new joint in these cases, such operation consisting in a removal of a piece of the lower jaw. The Messrs. Henry, C. Heath, Mac Comae, Mason, Lawson, and Annandale in this country have practised Esmarch's operation, and the success has been enough to indicate its great value. It must be mentioned that about the same year Rizzoli, of Bologna, performed a somewhat similar operation to Esmarch's, dividing the jaw but not removing any portion of it.

Operation of removal of piece of jaw.

Operation.—This may readily be done by making an incision along the lower border of the jaw, in front of the masseter and raising the integument, completing the operation by removing a wedge of bone, measuring about an inch above and a half below, with a hand or chain saw. Where only one side of the jaw is affected, it is without doubt the best operation that can be performed, the patients recovering their masticatory power in two or three weeks.

Deformities of the jaws.

Deformites of the jaws are sometimes seen as a consequence of some disease of the tongue such as hypertrophy, the mechanical pressure of tumours during its growth, the evil influence of cicatrices more particularly about the neck and mouth, and various other causes. For these surgery may often do much, but when this fails, the dentist can often give relief. I have seen the upper jaw in two cases of torticollis nearly one inch less in its vertical diameter than the opposite bone, and I have already alluded to a case where the lower jaw was nearly an inch higher than natural to make up for a deficiency in the teeth of the upper jaw and which had existed from childhood.

Dislocation of the Jaw.

Dislocation of the jaw.

This may involve one or both condyles, two out of every three cases being bilateral. It may be caused by direct violence on the jaw, but more frequently by yawning. Sir A. Cooper tells of a case in a child, where it was produced by the forcible introduction of an apple into the mouth, and dentists know of its being produced even by the extraction of a tooth.

FIG. 228.



Dislocation of lower jaw
Couper's case.
'London Hosp. Rep.,' 1864.

Varieties and causes.

Symptoms of double dislocation.

In the *double* dislocation, the mouth is widely open, the jaw fixed and projecting, the lips separated, and, as a consequence, speech is very difficult. Deglutition is much interfered with, and the saliva flows from the open mouth. In front of the ear, a marked hollow will be perceptible, and *above* the zygoma, in the temporal fossa, an undue prominence (Fig. 228). Adams, of Dublin ('Dub. Quart. Journ. Med. Science,' vol. i), first noticed these symptoms, and Mr. R. W. Smith ('Fractures,'

1854) believes them to be caused by the "displacement and stretching of the fibres of the temporal muscle on the upper surface of the condyle."

Single dislocation.

In the *single* dislocation, the chin is oblique, but usually directed towards the *sound* side instead of towards the *injured* side, as in fracture of the neck of the bone. In exceptional cases, however, this is not to be observed. The other symptoms are similar to those of double dislocation, the hollow in front of the ear being the most characteristic.

Congenital dislocations.

Congenital dislocations have been described by Smith, Guerin, Langenbeck, and Canton. Sir A. Cooper has also drawn attention to *subluxation*, in which he assumed that the condyle of the jaw slipped in front of the interarticular fibro-cartilage. It is caused and characterised by the same conditions as those of dislocation, and it is probably a partial dislocation forwards.

Reduction of dislocations.

TREATMENT.—Partial dislocations or those described as subluxations, are usually reduced by the patients themselves, by some little lateral movement of the jaw, or, by gentle pressure upon the chin. Cases of complete dislocation have likewise been similarly reduced; but more frequently, the surgeon's aid is demanded.

Mode of proceeding.

The patient should be placed in a chair with his head supported, while the surgeon stands in front. The operator, having well protected his thumbs with a towel or lint, may then introduce them into the mouth, and with the thumbs upon the last molar teeth he should firmly grasp the jaw. Pressure should then be made upon the teeth downwards and backwards so as to depress the condyles from their false position, at the next moment elevating the chin with the outer fingers. By these means reduction is readily effected (Fig. 229). Some surgeons prefer using a piece of wood or the handle of a fork to depress the jaws. When strong leverage is required, as in old cases, Stromeyer's forceps may be employed. It is well to reduce both sides together; and old standing dislocations may be thus reduced. Mr. Morley reduced one after thirty-five days, Spät after fifty-eight; Demarquay after eighty-three, and Donovan one after ninety-eight. (Heath.)

FIG. 229.



Reduction of dislocation of lower jaw.

Fracture of the Jaws.

Fractures of the upper jaw.

When the *upper jaw* is broken it is generally from direct violence, and, when the "key" was employed for the extraction of teeth a fracture of the alveolus was frequently the result.

Causes.

In severe injuries, much displacement may take place, and copious hæmorrhage follows. Cases are on record where the internal maxillary artery was ruptured and fatal result ensued. The infra-orbital nerve or its branches are occasionally injured when some loss of sensation in the cheek will be produced. I have known emphysema of the cheek or orbit to follow such an injury, and have seen sub-conjunctival hæmorrhage indicate it. One of the worst

examples of fracture of the upper jaw I have seen, occurred in a man, æt. 30, from a fall from a height. Both upper jaws were completely detached from the skull and could be moved about in any direction, yet a good recovery ensued. I saw a second in an asylum and it was caused by the blow of a lunatic's fist. In this case the whole of the alveolar process of the right upper jaw was broken off, and the lower fractured in two places.

Treatment. TREATMENT.—Where *no* displacement has taken place, little treatment is required; the parts should be left alone as natural processes will effect a cure. When *displacement* exists and can be remedied by manipulation, such means should be applied, some slight retentive bandage with or without a pad being employed to keep the parts in position. When the palate plate is much interfered with and displaced, the dentist's aid may be called into requisition, a gold plate well adapted to the parts tending to keep the fragments together; *vide* Salter, 'Lancet,' 1860. Hæmorrhage, as a rule, can be arrested by the application of ice or styptics. When the soft parts are injured and bleeding takes place from them, the vessel should be secured. When the bone is comminuted, there is no need for the removal of fragments; Malgaigne laid this down as a law, and all surgeons now follow it, though Hamilton asserts, that owing to the extreme vascularity of the bones composing the upper jaw, the fragments have been found to unite, after the most severe gunshot injuries. In rare cases of separation of the maxillæ, says Heath, a spring passing behind the head and causing pressure upon the maxillæ, after the manner of Hainsby's harelip apparatus, might be advantageously employed.

When comminuted.

Fractures of the lower jaw. Generally compound. *Fractures of the lower jaw* like those of the upper are, as a rule, the result of direct violence, and, when produced by gunshot injuries, are, at times, most severe. They are almost always compound, that is, towards the mouth, the gum tissues readily giving way. The body of the bone is more frequently broken than any other part, although the ramus and the neck of the jaw may be fractured. The line of fracture is generally oblique and very commonly near the canine tooth. Double fractures are very common, eleven out of twenty-four cases recorded by Hamilton being of this nature. Comminuted fractures are more rare. A case came under the care of Mr. Poland, at Guy's in which the jaw was broken in five places by the kick of a horse. The symptoms of fracture are generally very clear, crepitus being often felt by the patient in attempting to move the jaw, and readily made out by the surgeon. The irregularity of the teeth is also a very characteristic symptom, and the care of the patient to hold the parts in position conjoined with his inability to speak is a typical sign. When any doubt exists as to the presence of a fracture the mobility of the broken bones will disperse it. Considerable displacement sometimes complicates the case, the position and the line of fracture determining this point; an oblique fracture near the insertion of a large muscle, as the masseter, necessarily showing a tendency to override. In double fracture of the body of the bone, this displacement is usually very marked, the muscles connecting the lower jaw with the hyoid bone drawing the lower portion down. In some this displacement cannot be completely remedied.

Symptoms.

Fractures of the neck of the jaw. *Fractures of the neck of the jaw* are always the result of direct violence, and are not very readily made out; pain aggravated by any attempt to move the jaw being a constant symptom, and so also is cre-

pitus perceivable by the patient. "The condyle," says Heath, "is drawn inwards and forwards by the pterygoideus externus, as can be ascertained by passing the finger into the mouth, and the jawbone is apt to become slightly displaced, so that the chin is turned towards the affected side and not from it, as is the case in dislocation." I have had under my care a man æt. 35, with a fracture of both sides of the jaw, just below the condyles, and with fracture of the symphysis, produced by a severe blow upon the jaw below the chin; and, from the displacement that followed the house surgeon thought it was a case of double dislocation; but on attempting to reduce it, it went in without the characteristic snap of dislocation. Ostitis and necrosis of the whole bone below the necks followed; yet a new jaw formed and the man recovered with good movement of the bone.

Fracture of the coronoid process is very rare; and Sanson says that such a fracture never unites.

Treatment of fractures of lower jaw.

TREATMENT.—When the bones can be brought into apposition, the treatment may be described as simple; and where difficulties are met with in reducing the fracture, the treatment is most difficult and uncertain. In an ordinary case of fracture of the jaw, where no displacement, or very little exists, the common four-tailed bandage, a yard long, with a slit in the chin piece of about four inches, made and applied as illustrated in Fig. 230, is all that is necessary for *temporary* purposes, but for *permanent* treatment, in the few cases in which no displacement exists, it is well to mould on a splint of gutta percha, made according to the shape given below (B), and applied as seen in Fig. 231, A. When healthy teeth are present at the line of fracture they may

FIG. 230.



FIG. 231.



Bandage and splint for fracture of lower jaw.

be fastened together with wire, after the method of Hammond's splint (Fig. 235).

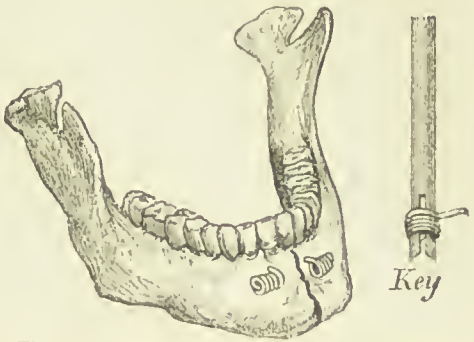
When difficulties are felt in the adjustment, as in double fracture, where the chin is much drawn down, a good pad may be firmly tied under the chin, or, a block of wood adjusted. In one case, I fixed a plaster cast, holding the jaw well in position by means of a piece of linen during the setting of the plaster. But in these cases, the surgeon's ingenuity is often taxed to the utmost to meet the wants of the individual case.

Some surgeons have suggested that the bones should be fastened together by sutures when all other means fail, and Mr. Hugh Owen Thomas, of Liverpool, has published cases to illustrate the practice. He applies the wire ligature after the fashion illustrated in Fig. 232, using a 1-24th inch silver wire, and fixing it with a key (Fig. 232). ('Lancet,' 1867, and pamphlet, 1875.) In the case of comminuted fracture already alluded to, two or three wire sutures were applied with the best results. Others advise the use of wedges of cork so adjusted between the teeth as to maintain the jaw in its right line. Hamilton speaks highly of gutta percha moulded to the teeth and gums within the mouth, and Tomes has invented a silver cap to fit the teeth for some distance, on each side of the fracture. Barrett carries out the same idea in vulcanite. Berkeley Hill's modification of Lonsdale's apparatus is serviceable, and Moon's splint, as made for him by Millikin is also excellent. It has the advantages of all the other interdental splints already enumerated, is readily adapted to a jaw of any size, and, being introduced separately, is easily applied and can be as readily removed when desired, without shifting the cap which fits the teeth on either side of the fracture. Moon's splint therefore seems to be the best interdental one we possess, and it should be used when simpler forms are inapplicable (Fig. 233).

On use of sutures.

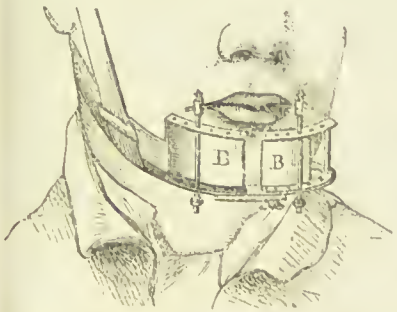
Moon's splint.

Fig. 232.



Thomas's mode of adjusting fractures of the lower jaw with wire and key.

Fig. 233.



Moon's interdental splint made in two halves, BB, with horizontal rods to keep cap, Fig. 233, in position.

Fig. 234.



Metal cap fitted over fractured jaw. Represented as wired on for a time, after the withdrawal of external splint.

Among these simpler forms, I must class "Hammond's," which I had brought under my notice in 1874, by Mr. Moon. It is a very simple and valuable splint for the general treatment of fractures of the jaw and has answered admirably in all the cases to which I have had it applied.

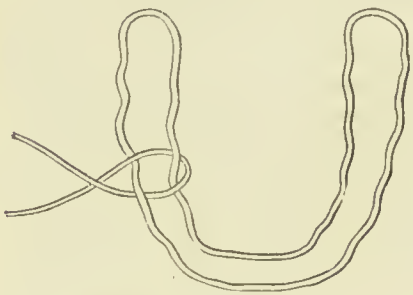
The following description of the apparatus and its application is given in Mr. Hammond's own words:—

"I first place the patient in as convenient a position as circumstances will permit, then direct him to rinse the mouth with alcohol and water

Hammond's splint.

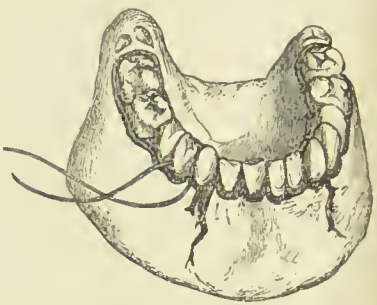
largely diluted, which not only cleanses the mouth but removes the fœtor of the breath. I next bring (temporarily) the broken ends into approximation by passing a silk thread between and round the two teeth on each side of the fracture, and then secure by tying in front. Then with a suitable tray and very soft wax I take an impression of the teeth, to which, after its having been cast in plaster of Paris, I adjust a frame of iron wire (Fig. 235), which can be done with a pair of small curved pliers. When all is ready I slip the frame over the teeth in the mouth (Fig. 236), and while it is held in position by an assistant, proceed to tie by passing small lengths of thin iron binding wire after the manner shown in Fig. 235, twisting them in front, until each ligature is nearly tight, turning the ends on one side until they are secured. Next, with the aid of an assistant I twist the wires quite tight, working alternately each side of the mouth, so as to exert an equal pressure, and thus bring the bone into a natural position, also

Fig. 235.



Hammond's wire splint for fracture of the jaw.

Fig. 236.



Hammond's wire splint applied to fractured jaw.

taking care not to overtwist or break them. I then cut off the ends and turn them in between the teeth. Now the jaw will be found comparatively firm, so solid, indeed, that the patient can bite steadily on it without pain. All that now remains to be done is to secure the jaw perfect rest by the four-tailed bandage." ('Monthly Review of Dental Surgery,' May, 1873.)

It is not absolutely necessary in all cases to take a cast of the broken jaw, although it is so in some, for the surgeon may mould a frame of iron wire upon another cast and adapt it to the special case without much difficulty.

This frame should be worn for six weeks.

DENTAL SURGERY.

By Mr. Henry Moon.

General Remarks on Dental Surgery.

Dental Surgery, in its manipulative details, must necessarily, for the most part, be left to those who make its practice a speciality, but some acquaintance with affections of the teeth, and with the principles on which they are treated, is required by every one who is engaged in the practice of medicine or surgery; for without such knowledge he will be unable to advise his patients on the preservation of their teeth (a subject of importance as regards their general

health), or save them from the sometimes serious local complications which may attend tooth disease. Nor will he be able to diagnose the true nature of certain tumours and cysts of the jaws, or to attach the proper importance to the teeth as the possible cause of neuralgia of the head and face, and of more remote nervous affections.

In the following pages only a sketch of this branch of surgery is aimed at, and the reader is referred for details to the excellent 'Dental Surgery' by the Messrs. Tomes, and to the interesting pages of Mr. Salter's work, 'Dental Pathology and Surgery.'

The various parts of our subject may, with advantage, be discussed in two main divisions. In the first section will be considered the defects in structure and abnormalities in form which may arise during a tooth's development, together with irregularities in its placement. In the second section will be considered the diseased conditions to which a fully formed tooth is liable, after it has assumed its destined position in the mouth.

The effect which disease or malposition of a tooth may have on the structures immediately around it, and on the general health, will also be noted.

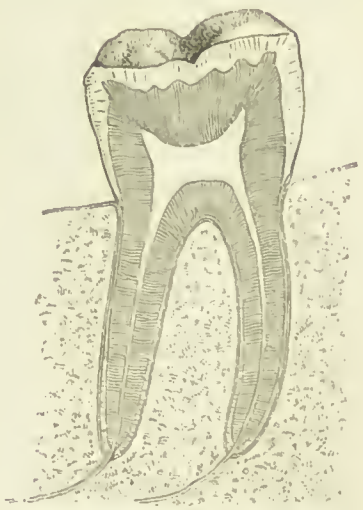
That a clear idea of these subjects may be obtained, some points in a tooth's development, structure, and connection with surrounding parts must be borne in mind.

Description of a Tooth—its Development and Connections.

A perfected human tooth (*see* accompanying illustration, Fig. 237) may be described as consisting of an unyielding case of dentine or ivory, enclosing a highly sensitive vascular pulp; the portion of this case that forms the crown of the tooth is protected by a covering of an extremely hard substance, "enamel," which, becoming lessened in thickness as it extends down the sides of the crown, finally terminates at the neck of the tooth; the portion of the case that forms the root or roots is covered by "crusta petrosa," or tooth bone, and is implanted in the alveolar portion of the jaw the crusta petrosa is covered externally by a sensitive and vascular membrane, "the alveolo-dental membrane," or "periodontum;" this membrane invests the root of the tooth and lines the bony socket, and is besides intimately connected with the dentinal pulp at the apex of the root, and with the gum also where the latter structure encircles the neck of the tooth.

The relation of the several tooth structures to each other.

Fig. 237.



Represents a vertical section through a lower molar tooth, showing its different component structures, and its connection with parts around.

Through the foramen at the end of the root blood-vessels and nerves pass for the supply of the dentinal pulp, while other nerves derived from the same source (viz. the second division of the fifth in the case

Vascular and nerve supply.

Implantation.

of the upper, and the third division in the case of the lower teeth) are distributed to the alveolo-dental membrane. The teeth are implanted in the alveolar process of the jaw, which is developed with them and is reabsorbed when they are lost.

Development.

Development.—The twenty developing temporary teeth, enclosed in their respective sacs, are contained in the jaw at the time of birth, as are also germs of the permanent molars and those of the anterior permanent teeth; these latter, receding from their position near the surface of the gums and becoming encapsuled, gradually pass down in the rear of the temporary teeth and remain embedded in the jaw, developing at leisure within their bony crypts until wanted to replace their more fragile predecessors. (*See* Fig. 239.)

Shedding of temporary, cutting of permanent teeth.

The following is the normal process attending the eruption of one of the anterior permanent teeth. The roots of the antecedent temporary tooth having been absorbed, its crown is shed, and the new tooth then gradually uprises from the gum—the protrusion of its crown taking place simultaneously with the coutinued elongation and development of its root.

Fig. 238.

Diagram showing the structures involved in deutigerous cyst and odontome formation.

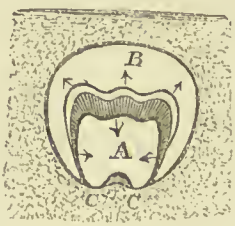


Diagram of developing lower molar tooth.

A. Dentinal pulp becoming centripetally encased by dentine.

B. Space occupied by enamel organ between centrifugally forming enamel and tooth sac. In this space fluid collects in the formatiou of a deutigerous cyst.

C. C. The base of dentinal pulp which remains attached and developing until the tooth is completed. By abnormal outgrowth at this point a radicular odontome would be formed.

Development.

The development of a permanent tooth thus occupies many years. Take, for examples, the first permanent molar and central incisor, the teeth which are the first developed of the permanent set. Their pulps commence to take form during fœtal life, their calcification commences by birth or in the first months of infancy. Their eruption takes place from the sixth to the eighth year, and their root canals with their terminal foramina are not reduced to their ultimate dimensions for two or more years later.

The three hard structures which enter into the composition of a tooth have distinct sources of origin. (*Vide* Diagram, No. 238.)

Enamel, dentine and crusta petrosa—their distinct sources of origin.

The enamel developed from the "enamel organ" of epithelial origin (which occupies the space B in the accompanying diagram) is formed *centrifugally* on the coronal dentine, and through the obliteratiou of its formative organ becomes on the eruption of the tooth incapable of further growth or nutritional change.

The dentine is developed from the "dentinal pulp" of vascular connective tissue (*vide* Diagram 238, A) by the immediate agency of a superficial layer of cells called odoutoblasts.

The dentinal pulp or bulb, arising from the bottom of the tooth sac, and projecting into its interior, grows up beneath the enamel organ and progressively takes the destined form and dimensions of the dentine just prior to the formation of that structure; thus, the free end of the bulb, having taken the form of the cutting edge or masticatory surface of the future tooth, becomes capped by dentine, which forms on it from without inwards; and this crown cap being formed, the remainder of the tooth is developed by the growth of the pulp at its attached surface or base (*see* Diagram 238, c, c) and its subsequent encasement by dentine. In the fully developed tooth the pulp comes to occupy a comparatively constricted central chamber corresponding in form pretty accurately to the external contour of the tooth, and this chamber may be yet further diminished in size by a renewal of the centripetal growth of dentine. Tooth pulp.

Dentine, remaining as it does in connection with its formative organ through the medium of the tubuli of which it is mainly built up, is capable of a certain amount of increased solidification even at its periphery, and under certain conditions is endowed with most acute sensitiveness. Connection of periphery of dentine with pulp.

The crusta petrosa is formed on the gradually elongating root through the agency of the dental sac or capsule which surrounds the forming tooth crown, and ultimately comes to invest the root in the form of the fibro-vascular, "alveolo-dental membrane."[1]

The alveolar portion of the jaw grows up with and is moulded around the developing teeth, and upon the eruption of their crowns, affords the teeth firm implantation, by closely surrounding their roots.

Having thus far traced a tooth's development, we now pass to the consideration of the effects which follow departures from this normal process.

Odontomes.

Tumours which result from the abnormal and excessive development of the dental structures at any time during the tooth's formation have been grouped together by M. Broca under the name of Odontomes,[2] and classified by him as follows :— "Odontomes."

I. **Odontomes embryoplastiques.**—Those which arise before the dental pulp has developed odontoblasts, and before the enamel organ has acquired special enamel-forming cells. Varieties.

II. **Odontomes odontoplastiques.**—Those which arise after the special dentine and enamel-forming cells have been developed, but prior to the formation of the coronal cap of dentine.

III. **Odontomes coronaires.**—Those which arise while the crown is forming.

IV. **Odontomes radiculaires.**—Those which arise during the formation of the root.

These four designations, pointing respectively to the periods in the tooth's development at which the hypergenesis of the pulp has arisen, also indicate to a certain degree the structural formation of a tumour

[1] From the dental sac is also probably derived the membrane known as the "cuticula dentis," or "Nasmyth's membrane," which in an unworn tooth is found continued over the crown, and is regarded by C. Tomes as an undeveloped cemental layer,

[2] Exostosis of the root and "dentine excrescence" in the pulp chamber are called by Mr. Salter "secondary odontomes," and naturally come under that designation, as might also the outgrowth of the pulp which sometimes follows the exposure of that structure; but as these are affections of the fully developed tooth, they will be considered in the second division of our subject.

formed at either period; but in adopting these terms it must be understood that, in one sense, the embryoplastic and odontoplastic conditions are present consecutively during the whole period of dentification, and also that if the odontoblast layer of cells is destroyed at any point, true dentine will not there be formed, although the pulp may undergo calcification, resulting in a kind of osseous structure.

Embryoplastic odontomes.—Under this name M. Broca ranges encysted fibrous and fibro-plastic tumours of the jaw. As the dental germ at the time of their origin contains no special dentine and enamel-forming cells, distinctive dental structures would of necessity be absent from these growths, and such absence must of course leave their dental origin in doubt.

Cases which render probable M. Broca's views on the dental origin of many jaw tumours.

In one instance (mentioned by Tomes) M. Robin met with a tumour in the lower jaw of a child, æt. 2½ years; this tumour, apparently fibrous, was studded with papillæ, on which distinct dentine and enamel were found. Now, whatever doubt may arise as to the origin of the before-mentioned tumours, there can be no doubt as to the dental origin of this one, and it is probable that in it a longer existence would have been accompanied by further dentification. In another odontome, which occupied half of the lower jaw of a girl æt. 2 years and 9 months, M. Broca found the formation of dentine proceeding at numerous points, and the fusion of these secondary bulbs, coated as they were with enamel organ, would result in bringing about the structural conditions found in an odontoplastic odontome.

Odontoplastic odontomes.

Odontoplastic odontomes, in outward form, may bear not the slightest resemblance to a tooth.

Structure.

Structurally they consist of a more or less confused mass of dentine, enamel, and osseous structure; the dentine occurring in tracts, between which the enamel has dipped down. Enamel is also found capping nodular projections which occur on the surface.

The case met with by Dr. Forget and reported by him may be cited as an example. A man æt. 20 presented himself with disease of the lower jaw, from which he had suffered since he was five years old; on looking into the mouth a hard smooth tumour was seen occupying nearly the whole of the left side of the lower jaw. None of the teeth beyond the first bicuspid were present. On removal (by section of the containing bone) this tumour proved to be a hard, oval, tuberculated mass, the size of an egg, chiefly composed of dentine, with enamel investing the nodules and dipping into crevices. Between the tumour and the osseous crypt which it occupied, there was a thick fibro-cellular membrane. The forming second bicuspid tooth and the crown of a molar were found impacted in the jaw through the superposition of this mass.

Origin.

The bulbs of one or more teeth, normal and supernumerary, may enter into the formation of one of these tumours, and surrounding teeth in various stages of development may become enclosed by it.

Malignant tumour simulated.

In one instance reported and figured by Tomes, a large tumour, presenting the appearance of a malignant growth, occupied the incisive region of the upper jaw of a man aged 25, his four upper incisors not having appeared. A probe introduced into the tumour impinged on something hard, which proved to be sundry masses of tooth structure, best described as odontomes, together with some ill-formed teeth. These specimens, numbering in all fifteen, are in the Museum of the

Odontological Society of London, and the case may, perhaps, be best described as one of disrupted odontoplastic odontome.

In a case reported by the late Mr. Harrison, an odontoplastic odontome occupying the space between the incisors and molar teeth, came away spontaneously. Spontaneous enucleation.

In one or two reported cases the tooth bulb having produced an eccentric formation such as described, instead of an ordinary crown, has afterwards assumed normal limits and formed fairly shaped roots.

Coronary Odontomes.—In these the main outline of the tooth is preserved, but an irregular outgrowth, more or less circumscribed, projects from the crown. This outgrowth, having arisen while the crown was in process of formation, consists of the coronal tooth structures, viz. enamel, dentine, and possibly enclosed pulp. If small and involving the neck of the tooth, an outgrowth of this nature may be at first mistaken for tartar. Coronary odontomes. Structure.

Somewhat allied to these cases are those in which a tooth presents one or two supernumerary cusps or supernumerary teeth merged with it. Allied malformations.

A small globular projection of enamel is also occasionally met with on the root of a tooth, and has been ranged among odontomes by Salter, who, finding that it caps a cone of dentine, calls it a "a submerged tooth cusp." The crown of a simple supernumerary tooth has been found attached in the same position, and probably these cases have a like origin.

Radicular Odontomes.—This form of tumour, which in several recorded cases has attained the size of a chestnut, is found attached to the neck and root of a fully-formed tooth by a more or less constricted base, and results from an irregular outgrowth from the dentinal pulp. Radicular odontomes.

Structurally, radicular odontomes generally consist of osteo-dentine more or less covered-in by a layer of dentine, with a coating of cementum externally. Structure.

FIG. 239.



Radicular odontome.

An odontome of this kind, embedded in front of the anterior margin of the ascending ramus of the lower jaw, and passing up behind the tuberosity of the superior maxilla, was recently removed by me at Guy's. This tumour (see Fig. 239) was attached to the lower wisdom tooth of a woman æt. 38. This patient had experienced no inconvenience from her mouth *up to the age of* 30, when great swelling over the ascending ramus occurred, accompanied by closure of the jaws and excruciating pain. These symptoms—*with intervals of complete cessation for two or three months at a time*—recurred until the odontome, which was gradually being extruded, was removed (very easily) by extracting the tooth to which it was attached.

In the case which is figured and reported at page 538 of this volume, Fig. 212, a symmetrical enlargement of the whole root occurred, producing a dilated hypertrophied tooth fang. Radicular odontome of unique form.

Odontoplastic and radicular odontomes are very rare, only a few cases of each in the human subject being recorded, but the recognition of the true nature of these tumours and of others which have a dental

Supernumerary teeth possible cause of dental tumours.

origin is of course of the highest importance, as it will avert an unnecessarily severe operation for their removal. In the case of tumours and cysts of the jaws the undue absence of any tooth will point to the probability of their dental origin, but the possibility of such origin would not be excluded if the normal number of teeth were present, as a supernumerary tooth may originate either an odontome or a dentigerous cyst.

A glance at the close packing of teeth in a child's jaw, as shown in Fig. 241, will show the strong probability of a dental origin for tumours and cysts of the jaws in young subjects, especially when it is remembered that each of the forty-eight teeth to be seen in such jaws at one time, is, or has been, the centre of developmental activity; the likelihood also that tumours may cause involvement or displacement of neighbouring teeth will be readily realised.

Fusion of teeth within common capsule.

Gemination, or the union of contiguous teeth, due to the fusion of their pulps, is met with occasionally in both the temporary and permanent sets. Normal teeth may be thus joined, or normal and supernumerary.

Dilaceration.

Dilaceration, or the abrupt change in the direction of the first and last formed portions of a tooth, sometimes occurs, and is due to a shifting of the forming tooth on its base.

Dentigerous cysts.

Dentigerous Cysts are cysts formed by the accumulation of fluid within the dental capsule at some period of the tooth's development, or around a fully developed tooth which has not erupted. They may therefore advantageously be classified, like odontomes, according to the point to which the tooth's development has proceeded, when the change occurs which eventuates in their formation.

Nature of.

When fully developed, a dentigerous cyst usually consists of a thick membranous sac, covered in by a thin osseous shell, formed by the expansion of the bone of the jaw. In a case met with by Mr. Fearn one half of the lower jaw was expanded by a cyst which separated its external and internal plates. The cyst wall itself in some instances has been found calcified. The cyst at first usually contains a serous fluid, which may become purulent through the occurrence of inflammation.

The unerupted tooth (temporary, permanent, or supernumerary) about which the cyst has expanded, may be represented by a small shapeless, calcified mass, if its formation was disturbed in the embryoplastic or earliest odontoplastic periods. This fact was well exemplified by the case of a girl aged 13, who was recently at Guy's under the care of Mr. Cooper Forster. Here two small irregular masses of dentine and enamel, the representatives of an absent canine and lateral incisor, were contained in two distinct cysts, which caused great protrusion of the anterior wall of the superior maxilla. The enclosed tooth may be attached firmly to the cyst wall, or may be found free within the cyst.

Dentigerous cyst of odontoplastic period.

Antral involvement.

A dentigerous cyst, forming in the upper jaw, may expand into and cause distension of the antrum. Professor Baum met with a case of immense dilatation of both antra, one containing a molar, the other a canine.

In some cases the tooth crown only, or the crown and part of the root, have been formed prior to the expansion of the capsule by serum, and these may be said to belong to the coronary and radicular periods. In other cases, again, the cyst develops around fully formed impacted teeth, which may be found inverted. In one instance mentioned by

Tomes, no less than twenty-eight separate and adherent denticles (or small supernumerary teeth) were found in a cyst of the upper jaw, and are probably to be looked upon as the elements of teeth that were missing.

Although both odontomes and dentigerous cysts have their origin in early life, years may elapse before the irritation caused by the presence of the odontome, or the increasing disfigurement and pain resulting from the enlargement of the dentigerous cyst, may lead a patient to seek surgical aid. Early origin. Gradual development.

Cysts developed on the root of erupted and fully formed teeth are not classed here as *dentigerous*, as they form only an appendage to the tooth. They will be referred to among the diseases of the teeth, but it may be here remarked that they sometimes attain to a large size and may, like dentigerous cysts, expand into the antrum, and also that their contents under inflammation may become purulent.

Supplemental teeth (*i.e.* extra teeth exactly corresponding to a neighbouring normal tooth) are occasionally developed in both temporary and permanent sets, usually in the front of the mouth. If they cause crowding or are placed before or behind their doubles, they should be extracted. Supplementa teeth.

Supernumerary teeth (*i.e.* teeth differing in form from any of the normal series) are not infrequently found in the upper incisive region and occasionally in other parts of the mouth. A pair of teeth somewhat resembling incisors, but of greater antero-posterior depth, and with a deep pit on their lingual aspect, are occasionally developed behind the permanent upper front teeth, and others more resembling small molars or bicuspids are also occasionally met with, but by far the commonest form that the crowns of supernumerary teeth present is that of a simple cone, or of a cone truncated and pitted on its summit, and these teeth have a characteristic straight terminal line to the enamel at their necks; they are, in fact, the most elementary form of tooth formation. Supernumerary teeth.

As a general rule, supernumerary teeth are to be extracted and will always be found to have a single root, which may, however, be contorted and expanded. Treatment.

Malformed Teeth.—Abnormalities in the form of teeth may result from the dwarfing or excessive development of the different parts or lobes, of which they are architecturally built up, and in certain cases are of great value in the diagnosis of constitutional peculiarities and in throwing light on the condition of health present during a patient's early years, when the teeth were in process of formation.

Syphilitic Teeth.—Mr. Jonathan Hutchinson first pointed out the association between congenital syphilis and a mis-shapement of the permanent teeth. This malformation is generally most strikingly apparent in the incisors, the upper centrals presenting the shape, diminution in size, and often the slight change in direction shown in Fig. 240, A, instead of the normal condition represented in Fig 240, B. These dwarfed teeth present differences of form, but the most characteristic change in them is their lessened breadth at the cutting edge as compared with that of their necks, the vertical groove on their anterior face being often absent, and the notch on their cutting edge not being an absolutely constant feature, and being also subject to obliteration through wear. The lower incisors usually present a corresponding Syphilitic teeth.

shape, and the other teeth may have their corners rounded off, and in the case of the canine be notched. The shape of the first permanent

Fig. 240A.



Fig. 240B.



molars is almost invariably altered (a fact, I believe, not hitherto pointed out), the suppression of their angles giving them a dome-like form, their size being often reduced, and the enamel absent from their masticatory surfaces.[1]

The above-described malformation is essentially due to a change in form of the dental pulp prior to its dentification.

Some children, recently seen by me, present, together with great peculiarity of their eyes and a general weakness in the development of their dermal structures, the following peculiarities in their teeth:—The middle lobes are sharp, recurved, and excessively developed, while the lateral lobes are dwarfed. In these cases, however, the pointed form of tooth which results can be readily distinguished from the truncated cone-like form indicative of congenital syphilis, as the latter is due to a dwarfing of the central lobe and a leaning inwards of the lateral lobes.

Syphilitic teeth quite distinct from the honeycombed.

The syphilitic tooth with its conical form is also by no means to be confused with the teeth which present a narrowness of their cutting-edge due to an absence of enamel from the first-formed portion of the crown, a condition often seen in the so-called honeycombed teeth now to be noticed.

Honeycombed teeth.

The rocky or honeycombed condition of a tooth's crown results from an irregular and insufficient development of enamel, producing horizontal groovings or a pitting of its surface.

Causes.

Mr. Hutchinson considers that the most frequent cause of this defect is the administration of mercury in infancy; and in many cases seen by me it appears traceable to the use of one of the most popular of teething powders, which contains calomel together with an opiate. It is not, however, certain that convulsions and other illnesses in childhood may not produce it.

The first permanent molars on their masticatory surface most often show the absence of enamel, while the incisors and canine are affected to an extent which depends on the amount of their development while the agency which arrests the enamel formation is in action; the later formed bicuspids, second molars, and wisdom teeth, often altogether escape.

The irregularly formed enamel may be structurally defective, as shown by its discoloration, and this may conduce to decay, as does also the pitting of the enamel if it extends through to the dentine. In other cases the diminished size of these teeth, which prevents their being crowded and exposes their sides to healthful friction, renders them less obnoxious to decay than might have been expected.

[1] The absence of enamel here mentioned may, however, be due to the administration of mercury, as the malformation typical of congenital syphilis may be seen well marked without any enamel defect in cases uncomplicated by mercurial treatment. The same remark may be applied to the discoloration that has been observed in syphilitic teeth.

Imperfections in Structural Development.

Structural defect conducing to decay.

Malnutrition.

At the present day the early decay and loss of teeth is very common, and is probably in part due to an insufficient supply of food containing the elements which go to build up the osseous structures,[1] malnutrition in early life, from whatever cause, leaving inevitably its mark on the exteriors of the teeth, which, once ill formed, have no power of reemperation.

Structural defects in enamel development.

Sound enamel.

Perfected enamel contains upwards of 95 per cent. of earthy matter, and consists of rods united together without intervening matrix, and placed at right angles to the surface of the dentine. Enamel, when well formed, is semi-transparent, but when defective from a want of homogeneousness in its structure it presents an opaque white, chalky appearance, and is then easily disintegrated. At the bottom of the natural sulci of otherwise well-formed teeth enamel is sometimes deficient in thickness and in soundness, and this favours the ingress of decay.

Defective enamel.

Structural defects in dentine formation.

Dentine.

Well-formed dentine is uniformly dense and ivory-like. It is built up of tubuli and intertubular substance, the tubuli serving to convey nutrition from the pulp to the periphery. Dentine is endowed with sensitiveness through nerves (probably too small for demonstration), which pass from the pulp to the surface and render the dentine immediately beneath the enamel especially sensitive.

Imperfections in dentine.

Through imperfect development a (so-called) granular layer which is found on the surface of dentine in the root may be present on the surface of coronal dentine. The (so-called) globular condition of dentine is another developmental defect. When the enamel covering is lost, imperfect dentine softens rapidly under decay without becoming darkened, and is also apt to be exceedingly sensitive.

Cutting of the Teeth.

Lancing of gums.

During the eruption of the temporary teeth, if there is disturbance of the general health traceable to dental irritation, and especially if there be the least sign of cerebral disturbance, there should be no hesitation in freely lancing the gum—tumid or tense—which covers the tooth that is presenting. In the case of a front tooth a straight incision should be made on to the front of its cutting edge; in the case of the molars a crucial incision should be made from corner to corner.

As a rule the permanent teeth erupt very easily, but an incision with a lancet may sometimes with advantage be had recourse to in cases where cerebral disturbance is easily excited, and it is often well to remove bodily the gum from above an erupting wisdom tooth when an antagonist tooth bites upon and irritates it.

Irregularity of Position.

Irregularity.

Irregularity of arrangement hardly ever occurs among the temporary teeth, but an undue prominence of the upper incisors, which sometimes is acquired, and a tendency to underhanging, from the over-development of the lower jaw as compared with the upper, should

[1] In infancy and childhood plenty of good milk and the use of "*whole* flour meal" are to be recommended; it is to be borne in mind that until a child begins to take animal food, the above are the sources of supply of lime salts.

receive attention, in order that these conditions may not be perpetuated in the second set. The absence of the spacing of the temporary teeth, which should precede their shedding, will point to a likelihood of crowding among the coming permanent teeth, and demand watchfulness.

Contracted jaws in the young.

Irregularity of the permanent teeth often results from the want of timely extraction, and even oftener from the untimely extraction of temporary teeth. It therefore behoves the surgeon who may be called upon to extract teeth for young subjects to acquaint himself with the time of eruption of the different permanent teeth, and with the points of difference between temporary and permanent teeth.

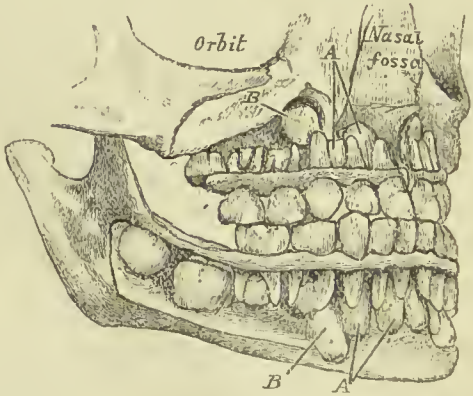
Well-developed adult jaws should consequently be thoroughly studied as a type, and compared with the jaws in childhood. It will be then seen that development has occurred longitudinally backwards for the accommodation of the permanent molars, while the part of the jaws that was occupied by the ten temporary teeth, having undergone additional development on its anterior face, is in the adult occupied by the incisors, canines, and bicuspids. In order that these latter may have room for even arrangement, it is important that the anterior permanent molars (the six-year-old teeth) should *not* be allowed to take up a too forward position, which they will do if the temporary molars are prematurely lost from neglected decay. On this account, therefore, the timely stopping of the back temporary molars is a practice to be recommended.

Preventive measures.

The accompanying figure will show how easily irregularities may be brought about, as the retention of the root of a temporary tooth is enough to prevent the permanent tooth from taking up its proper position.

In judging of the amount of space that there will be for the accommodation of the coming teeth, it is to be remembered that the alveolar portion of the jaws grows up with and is moulded around the teeth it supports, and that there is a strong tendency for teeth to assume their proper position (the action of the tongue and lips conducing thereto),

FIG. 241.



A. Permanent incisor teeth.
B. Permanent canine.

Drawing of jaws of child æt. 6. A and B point to permanent incisors and canines. The bicuspids are seen embraced by the roots of the temporary molars. The permanent molars, with the exception of the wisdom, are present.

while the replacement of the temporary molars by bicuspids increases the space for the front teeth.

A very common form of irregularity results in otherwise well-developed jaws from the permanent upper incisors being erupted to the rear of their unshed predecessors. In such a case the prompt removal of the temporary tooth is demanded, for if, on the further elongation of the upper permanent incisor, its edge once passes behind the incisor of the lower jaw, at each closure of the mouth the evil is increased, and can then only be corrected by the use of a regulating plate. On the same score, lower incisors may sometimes be kept in the rear of the temporary teeth in order that they may be ready to wedge forward the upper incisors, and thus *secure the overlapping of the upper front teeth* which allows of their true incisive action while it spares them undue wearing away.

Upper front teeth should overlap unders.

In spite of the above precautionary measures at the time of the second dentition, cases of irregularity will occur from malformation and insufficient development of the jaws. Some of the slighter of these irregularities are amenable to surgical treatment—that is, a timely extraction will allow nature to set all straight—but if a tooth is taken out on one side of the mouth to relieve overcrowding, the preservation of symmetry will often demand the extraction of another on the opposite side. The patient's profile and the relative prominence of the upper and lower dental arches have to be considered in deciding whether permanent teeth should be extracted for regulating purposes, while the soundness of teeth, the direction taken by their roots, the firmness of their implantation, and their comparative durability, are all points to be considered in deciding which tooth should be sacrificed for the benefit of the remainder.

Facts to be considered in extracting for irregularity.

Sometimes the first permanent molar may with advantage be taken out when the tendency to overcrowding is decided. If this tooth, which is particularly liable to decay, is past hope of permanent preservation by stopping, its extraction in time allows the second molar to come forward and partly occupy its site, and the wisdom tooth to come well into place, while it also enables the front teeth to spread, and thus escape undue lateral pressure and consequent decay.

On the extraction of the six-year-old molar.

The one valid objection to the extraction of the first permanent molar, under the above circumstances, occurs when the withdrawal of the prop which this tooth affords at the back of the mouth would cause the lower incisors to bite up unduly on to the necks of the uppers and drive them forward.

Here it may be remarked that in all attempts to improve the regularity of the teeth the relative positions of the antagonist teeth in the other jaw must be taken into account.

The "bite" to be considered.

So far only those cases have been considered that are capable of being benefited by timely extraction, but many cases require for their treatment the use of mechanical appliances. Among these appliances a lever for expanding the arch of the upper teeth (while it presses back the lower) and elastic bands are of great use; while in more advanced cases a regulating plate must be worn, the principle of its action being that it affords a fixed point from which continuous pressure or traction is kept up on the teeth to be moved.

Regulating appliances.

The movement of teeth by mechanical means should be gradual, or absorption of bone will result without a compensatory development,

and the teeth will he loosened. Twisted teeth ean he turned on their axes. Instanding upper front teeth ean be trained out, and will be retained in their new positions as soon as they are hrought to overlap the lower teeth; prominent and projeeting upper teeth ean be gradually trained in, hut will be required to he kept in plaee for some time by meehanieal means to prevent their revertiug to their original position. The lower lip passing hehind prominent upper ineisors inereases the deformity whieh is usually assoeiated with a eontracted areh.

Rabbit-mouth.

In regulating teeth mueh greater diffieulty has to be overeome where eontraetion or malformation of the jaw eauses the irregularity, than in those eases where there is simple misdireetion of the teeth themselves.

Underhanging.

In some eases eomplete underhanging of the jaw is present, *i. e.* the upper teeth, haek as well as frout, are set within the areh of the lower teeth; this eondition does not admit of mueh remedy when onee firmly estahlished, but may he prevented to a eertain extent by timely extraetion of lower teeth together with a training out of the upper. The earlier that irregularities reeeive attention the hetter, in order that the misplaeement may not be inereased, and also beeause the moving of teeth ean only be safely effeeted in the young.

Insufficient room for canine and wisdom teeth.

Canine and wisdom teeth, owing to the lateness of their eruption and the position they oeeupy during development, are peeuliarly liable to be shut out from the dental areh. The eanine heing a durable tooth, should in some eases have room made for it by the extraetion of one of the teeth that have elosed in upon its site. The eutting of wisdom teeth is frequently attended with mueh trouble, and it may be remembered in the ease of yonug subjeets with small maxillæ, whose first or seeond molars are mueh deeayed, that the timely extraetion of either of these teeth may allow the wisdom tooth (if developed) to erupt easily and oeeupy a useful position. In the upper jaw, if the wisdom is foreed to take an outward direetion, and so eause irritation of the eheek, it should be extraeted. In the lower jaw, where there is insuffieient room for it between the seeond molar and the aseending ramus, its efforts to erupt often prodnee nerve irritation, ehronic spasm of the masseter, the formation of pus hetween the erown of the tooth and the superjaeent gum; it may also eause ahsorption of the root of the second molar and lay hare its pulp.

Impaction of lower wisdom.

In all eases where the impaetion of a lower wisdom tooth is a souree of irritation, the inpaetion should he at onee got rid of either hy the extraetion of the wisdom tooth or of the tooth in front. The operation

Treatment.

required, as well as the serious resnlts whieh may atteud purulent inflammation ahout an impaeted wisdom tooth, will reeeive notiee later.

Misplacement.

Teeth are sometimes erupted in strange positions; thus, Salter reeords a ease of inversion and eruption of lateral ineisors in the nares, and Tomes figures the ease of a molar erupted in the median line of the palate, and another ease in whieh the erown of a molar piereed the eheek at the angle of the jaw. In another ease, figured by Tomes, the erown of a molar presented at the sigmoid noteh, but remained impaeted.

Impaction of teeth.

Impaetion, or retention of a tooth within the maxillary hone often oeeurs without any ill results, but oeeasionally it is produetive of severe misehief. Thus, in a ease whieh oeeurred in the praetiee of Mr. Cartwright, sen. (and whieh is reported at length by Mr. Salter), it

was productive of severe neuralgia. In this case the presence of an impacted upper canine, which caused a prominence on the palate, gave rise for eight years to constantly recurring, most severe neuralgic pain, confined to a circumscribed spot on the left side of the vertex of the head. In other cases it may give rise to cystic enlargement or abscess, the latter, perhaps late in life, from the buried tooth becoming more superficial through absorption of the containing bone. The palate may be involved if a tooth is impacted within the palatine process of the superior maxilla, or an abscess may be formed below the tongue from impacted lower teeth.

Complication resulting from impaction.

The following case was reported by Mr. McCoy in the 'Lancet,' 1871:—A boy, æt. 14, had a tumour of the antrum the size of an apricot, due to an impacted canine, the crown of which projected into the antrum, while the root was impacted in a socket in the nasal process; the antral cavity contained a little glairy fluid, but was chiefly filled by a gelatinous substance—apparently thickened mucous membrane.

Absence of Teeth.—A few cases are recorded of edentulous jaws. Wisdom and upper lateral incisors, the teeth most liable to variation in size and shape, are also the most liable to suppression. Occasionally other permanent teeth fail to make their appearance, in which case it may be right to leave their predecessors undisturbed, if they show no signs of loosening; temporary molars may in such cases serve for many years.

Non-development of teeth.

The tendency of particular teeth to take irregular positions, and the liability of others not to be developed, are facts that have to be borne in mind in connection with the probable dental origin of tumours and cysts of the jaws.

Odontomes and dentigerous cysts.

Before passing to the second division of our subject it may be useful to enumerate the morbid conditions which may be simulated by the tumours, cysts, &c., which originate from an unerupted tooth in the ways described in previous pages.

The affections they may simulate.

Odontomes may give rise to appearances such as may be presented by benign or malignant tumours, whether arising spontaneously or due to the impaction of a foreign body, such as root of tooth, splinter of bone, or a bullet.

Dentigerous cysts, when slowly forming and before they have thinned the enclosing bone to an extent which would allow of the characteristic sign of *craquement* on pressure, may be difficult to diagnose from solid tumours.

A dentigerous cyst may also produce the same symptoms as a cyst formed on the root of an erupted and diseased tooth, and when through inflammation its fluid contents become purulent it may, in like manner, resemble an alveolar abscess (*i. e.* an abscess formed around the root of a diseased tooth), and, like it, will be apt to give rise to a fistulous opening.

Empyema of antrum.

Suppuration in the antrum, or Empyema, arises probably in two distinct ways. In the one case it is due to inflammation of the lining membrane of the cavity, which, being continuous with the mucous membrane of the nose, allows of the escape of the contained purulent fluid into the middle meatus by the natural orifice. In the other case the pus is contained in a sac which has expanded into the antral cavity, carrying the lining membrane before it, and then the pus does not find exit by the nasal opening; this latter condition (as pointed out by

Otto Weber) is generally present when the root of a tooth originates the mischief by penetrating the cavity and when an alveolar abscess extends into it, while cysts formed on a root, and dentigerous cysts expand into the cavity in this manner and may afterwards suppurate.

Diagnosis. The history of these cases may throw light upon their nature, while a careful examination of the mouth should be made to decide whether the due number of permanent teeth have been erupted, and as to the existence of disease in any tooth in the neighbourhood of the tumour. An exploratory puncture or opening should be made in any case that may have a dental origin, before any serious operation is undertaken for the extirpation of the disease.

Treatment. For treatment it will here suffice to say that the complete removal of any tooth or dental formation involved is demanded, and that for the remaining treatment the ordinary rules of surgery apply.

Diseases of the Teeth.

Dental pathology. The largeness of the nerve supply to the dental pulp and periodontal membrane, and the liability to irritation and inflammation to which these confined vascular structures are subject, give an importance to diseases of the teeth which they would not otherwise possess; the pain, direct or reflex, which nearly always attends the involvement by disease of these dental vascular structures, and the serious local lesions which may follow their suppurative inflammation, often cause the mere destruction of the tooth as an organ of mastication to be a matter of secondary importance, although in itself sufficiently regretable. Bearing in mind the description of a tooth given at page 557, it will be understood how the maintenance of a tooth in its usefulness depends on the integrity of its component structures, and how it happens that the pulp and alveolo-dental membrane, which, in a condition of health, are tissues simply subsidiary to the nutrition of the hard structures around them, become—when the tooth is attacked by disease—the parts which have especially to be protected from invasion.

Morbid conditions which cause irritation of dental nerves. The morbid conditions which may produce irritation of the dental nerves may with advantage be grouped in two divisions.

The first division, including those which cause irritation of the nerves supplied to the pulp with their continuation into the dentine, consists of—

(*a*) Exposure to irritation of sensitive dentine, through loss of enamel resulting from Caries, Erosion, or Fracture.

(*b*) Irritation and chronic or localised inflammation of the pulp when deprived of its protective covering of dentine through the more extended action of the destructive agencies named under (*a*).

(*c*) General inflammation of the pulp, following sooner or later on the previous conditions, and resulting in its sphacelus.

(*d*) Irritation of the pulp through the presence of irregular formations of secondary dentine in the pulp chamber.

The second division, including the morbid conditions that cause irritation of the nerves supplied to the alveolo-dental membrane and to the dental nerves external to the tooth, consists of—

(*a*) Dental Periostitis, *i. e.* inflammation (plastic or suppurative) of the periodontal membrane. This results by far most commonly from inflammation and sphacelus of the dental pulp; it may be idiopathic, may be produced by irritation of the periodontum at the neck of the tooth where it meets the gum, may be set up by exostosis, and occa-

sionally results from the undue pressure of an opposing or contiguous tooth.

(*b*) Exostosis (*i. e.* hypertrophy of the crusta petrosa), sometimes resulting from, sometimes the cause of irritation and inflammation of the periodontum.

(*c*) A needle-like pointing of the end of the root, and a roughening of its end by absorption.

(*d*) Impaction of permanent teeth in the maxillary bones, and futile attempts to erupt made by such teeth, especially in the case of lower wisdoms.

(*e*) Overcrowding of the teeth.

Odontalgia.

Irritation of the dental nerves may excite pain at the point of irritation, producing toothache, the pain being either confined to the faulty tooth or being centered in it and radiating to the adjoining teeth and to the nerves of the same side of the face and head, but not infrequently it gives rise to reflex pain, in which case the tooth at fault often escapes suspicion on account of its freedom from pain. More remote sympathetic nerve affections are also sometimes caused by dental irritation.

Reflex nerve irritation.

A most unequal amount of pain or nerve disturbance occurs in different subjects from dental lesions of an apparently similar nature. Such differences must be referred to structural peculiarities of the teeth and to the conditions of health and to the diathesis of the patient.

Neuralgia.

A faulty tooth is the real origin of many cases of neuralgia about the head and face, although cold or depressed vital power will determine the time of onset.

That remote sympathetic pain may be due to dental irritation will be easily realised by any one who has felt the distribution of his spinal nerves demonstrated on the scraping of sensitive dentine in his tooth.

Toothache, varieties of.

Toothache (or localised dental pain) varies in character according to the part of the tooth involved; these differences will be apparent as the effects of disease in the several dental structures are considered, but it may be here remarked that a darting pain (which may fade away with an ache) betokens irritation and probable exposure of the pulp—

From pulp irritation.

that intense pain of a violent throbbing character points to general

From general inflammation.

inflammation of the pulp and may be expected to cease entirely with the destruction of that structure's vitality, and that the pain which

From periodontitis.

attends irritation and inflammation of the periodontal membrane is of a dull or gnawing character; but may assume a throbbing character if an alveolar abscess is formed.

Hyperæsthesia of pulp.

Hyperæsthesia of the pulp may be expected to coexist with the conditions which act on its nerves, and is evidenced by sensitiveness of the tooth to heat and cold. A hot instrument applied in succession to the crowns of suspected teeth may afford valuable evidence on this point, and tapping the teeth may also reveal the over-sensitiveness of any one tooth. Slight periosteal irritation may accompany this condition.

Peri-odontitis.

Dental periostitis at its onset is often attended by a sensation of fulness in the tooth, which inclines the patient to press it firmly into its socket; this sensation is succeeded by painful tenderness on pressure of the tooth, which is often slightly raised and loosened, while the gum, which at first presents a narrow red line around the neck of the tooth, tends to become diffusely red and tender over the root.

Symptoms.

In obscure eases of pain the presence or absence of circumscribed periodontitis and of irritation due to exostosis may be diagnosed by pressing the crown of the tooth in different directions so as to tilt the end of the root against the socket; the biting of something hard with one tooth after another may also be adopted as a means of finding out if irritation of this obscure nature is present in a root.

Reflex Nerve Affections due to Dental Irritation.

The nerves of the second and third divisions of the fifth are more liable than any others to reflex affections due to dental irritation. Next to the several branches of the Trigeminus, the nerves of the Cervical and Brachial plexuses are most often involved.

Neuralgia. **Neuralgia.**—The following are the most common sites for the manifestation of reflex pain.

(*a*) Another tooth to the one in fault, frequently the one that antagonises it in the opposite jaw, and occasionally a tooth in front of the one irritated (thus, an innocent bicuspid may ache when the wisdom tooth is at fault).

Hemicrania. (*b*) The side of the head with the focus of pain near the parietal eminence, due to irritation of a tooth (generally an upper back one) of the same side; this is the source of many cases of unilateral headache.

(*c*) The eyebrow with the focus of pain at the supra-orbital notch, and the cheek with the focus of pain at the infra-orbital notch, the irritation in these cases being located in the upper teeth.

(*d*) From irritation of the back lower teeth there may result earache, and pain extending over the temple, and also pain passing down the neck.

Pain over the upper cervical vertebra appears generally to come on secondarily to the above-mentioned neuralgiæ.

More remote Nervous Affections.

Pain, to quote the words of Mr. Salter, is only one of the phenomena of reflex dental nerve irritation. There may be produced muscular spasm and muscular paralysis, paralysis of some of the nerves of special sense, perverted nutrition. In these pages an enumeration of some of these affections can only be made, and the reader is referred for details of cases to the work on 'Dental Pathology and Surgery,' by the above-named author, and to the second edition of 'Tomes' Dental Surgery.'

List of sympathetic nerve affections due to dental irritation. The following secondary and remote nervous affections may arise from irritation in the teeth, and be curable by the removal of the exciting cause:

Convulsions, &c., resulting from irritation in teething.

Epileptiform seizures. In these cases, when an uneasy sensation is felt in the mouth previous to the attack, the best results may be hoped for from stopping or extraction, as the case may demand.

Delirium from retarded eruption of wisdom teeth.

Firm closure of the mouth through chronic spasm of the masseter muscle is a frequent complication of irritation in or about the lower back teeth.

Wry neck. Pain in the course of the cutaneous branches of the cervical plexus.

Partial paralysis of the arm and hand, with an inability to grasp with the fingers, accompanied by aching pain. (Several such cases have recently been under my observation, a fact which shows their comparative frequency.)

Amaurosis. Strabismus. (Ptosis and deafness are also recorded complications.)

Ulceration in the course of a branch of the fifth nerve.

A case of obstinate leucorrhœa and acute uterine pain cured by the extraction of a tooth was recorded by the late Mr. Screombe.

One case of fatal tetanus is quoted by Mr. Tomes as having followed the operation of pivoting.

Such are some of the reflex pains and remote complications which may arise from dental irritation in a patient of neuralgic diathesis, but apparently similar exciting causes are constantly present without producing any such results.

Dental diseases.

In an apparently sound tooth an irregular formation of dentine in the pulp chamber is sometimes the cause of neuralgic pain, and may be suspected if hyperæsthesia of the pulp exists in a tooth exhibiting no other causes for over-sensitiveness.

Exostosis and occasionally needle-pointing of the fang may also be the cause of neuralgic pain at the root of a sound tooth, and may have their probable presence revealed by the tooth exhibiting tenderness on pressure into the socket, and perhaps, later on, by other evidences of periosteal irritation. Being otherwise irremediable, extraction is demanded in these not to be foreseen conditions.

Their progressive character.

With the exception of the above comparatively rare cases it will be noticed by referring to the list of morbid dental conditions given at page 570 that all the affections there enumerated may result from the spread of disease from one dental structure to another, and therefore demand treatment for their prevention and limitation. Thus, when the exterior of a tooth is the first part attacked—as it always is in caries and erosion—the aim should be to preserve the pulp from irritation and exposure, and when the pulp is already exposed through the above diseases or by fracture, the aim should be to prevent its inflammation; while if the vitality of the pulp is past saving, means should be taken to prevent the involvement of the periodontum, and finally, if that tissue is involved, extraction of the tooth may be demanded to relieve pain and to prevent the formation of alveolar abscess with its possible complication of fistulous openings on the face, or the still graver consequences which inflammation external to the tooth may bring about.

Peculiarities in structure of tooth that aid its conservation.

Three facts in the nature of a tooth aid dental surgery in its conservative efforts. The first is, that the dense and evascular character of the enamel and dentine allows a diseased portion of them to be removed and the remainder to be preserved by friction, or by a filling inserted in the place of the removed portion.

The second favouring fact is the continued presence on the surface of the pulp of the odontoblast layer of cells, ready to form secondary dentine over the pulp and thus shield it, if they are stimulated to renewed action by irritation of the primary dentine.

And thirdly, the small calibre of the root canal in a perfected tooth, and the minuteness of the aperture that remains at the end of the root for the passage of the vessels and nerves, cause the pulp to be so comparatively isolated, that, when diseased, it can with safety be destroyed

by escharotics and be extirpated, before its sphacelus has involved the structures external to the root.

Caries, its great prevalence.

The practical remark may here be made, that up to middle age, probably 90 per cent. of the teeth that are lost owe their destruction to caries, while later in life recedence of the gums and absorption of the alveolus—often prematurely induced by the presence of tartar—leads to the loss of many teeth by depriving them of implantation.

Before reviewing the agencies destructive to the teeth, it will be well to consider the nature of secondary dentine and cemental exostosis, which occupy a debatable position between physiological and pathological tooth formations.

Secondary dentine.

Secondary Dentine.—Three different developments come under this name. The *first*, called by Salter "Dentine of repair," has been alluded to already. The loss of dentine externally through abrasion, caries, erosion, or fracture, will oftentimes produce compensatory development internally—at the point where the affected dentinal tubuli abut on the surface of the pulp; this reparative growth prevents pulp exposure when, from attrition, the enamel and a considerable portion of dentine have been worn away from the surface of a tooth, and sometimes it will obliterate the pulp chamber. In cases of decay "dentine of repair" does not often, unaided, prevent exposure of the pulp, but it hinders it, and becomes a valuable auxiliary in its protective treatment. (*See* Bicuspid, in D, Fig. 243, p. 579.)

Different kinds of.

Dentine of repair.

Second form.—Cases have been described by Salter and others in which a nodular outgrowth of dentine or osteo-dentine has projected into the pulp chamber of a sound tooth, and has given rise to severe neuralgia. This development must be regarded as morbid, and has been named by the above author "Dentine excrescence."

"Dentine excrescence."

The *third form* of secondary dentine is essentially an affection of the pulp. "Intrinsic calcification" is the name proposed for it by Mr. Salter, who has described its formation as thus occurring:—Isolated masses of osteo-dentine form, at first usually in the axis of the pulp; these masses enlarge and merge into one another and spread towards the periphery, and may at length occupy the whole of the pulp chamber. This formation may be regarded as sometimes resulting from and as sometimes the cause of pulp irritation.

Intrinsic calcification.

Exostosis.

Exostosis is a term applied to enlargement or outgrowth of the crusta petrosa (*see* Molar, in E, Fig. 243), ranging in amount from a slight general thickening (when it can hardly be regarded as pathological) to an outgrowth which may double the size of the root and sometimes has fused together the roots of contiguous teeth. The deposition of cementum may alternate with its absorption, and not infrequently it will be found thickened on the upper part of a root where chronically inflamed periosteum exists, while the end of the root will be bare of it and be bathed in the pus of an alveolar abscess. It often causes a globular enlargement of the end of the root. Sometimes small excrescences of it will form on tooth after tooth, and by giving rise to most severe neuralgia will necessitate their extraction.

Exostosis may arise secondarily to inflammation of the periodontum, and will then be accompanied by extra vascularity and tenderness of adjacent gum, &c. The means for detecting its presence in its early stages, when arising primarily and causing neuralgia, have been already mentioned; symptoms that will be likely to attend its pro-

longed presence as a source of irritation are those of periodontal inflammation.

The nature of the agencies that destroy the dense structures of the tooth will now be considered, and inasmuch as the sequence of disease, when once the pulp is exposed, is much the same whether the exposure has occurred through caries, erosion, or fracture, the treatment of progressive dental disease and the various affections of the pulp will be considered and illustrated once for all; and, finally, dental disease external to the root, with its complications, will receive notice.

The great prevalence of caries at the present day makes it desirable that its nature and the means for its prevention should be understood. These subjects will therefore be discussed somewhat at length. Caries.

Dental Caries or Decay

may be described as the disintegration of the hard structures of the tooth by decalcification. It always commences on the exterior of a tooth and saps inwards; when the crown is attacked by it, a fault in the enamel is the first step in its course, and may be due to original faulty development or to mechanical or chemical injury. Always begins on exterior of tooth.

Fracture may produce the enamel lesion.

A frequent cause of disintegration of the enamel is the attrition exercised by the sides of crowded teeth on each other, and as this sets up interstitial decay a nidus is thereby formed, which serves as a laboratory for the production of chemical destructive agents which act on the adjoining tooth. Interstitial decay in one tooth causes decay in the next.

The chemical solvents are formed by acids chiefly derived from the buccal mucus and food mixed with saliva, which—lodging between the teeth and in natural depressions—undergo decomposition. In the formation of acid, carious dentine, when once a cavity is formed, takes a part.

A fungoid growth going by the name of "leptothrix buccalis," which is found in the mouth, is constantly present in carious teeth and probably helps in the disintegrating process.

Overcrowding of the teeth, viscid buccal mucus giving an acid reaction, a vitiated condition of the fluids of the mouth due to derangement of the digestive organs, the eating of sweetmeats (as carried by some young people to a most injurious extent), conduce to decay and should therefore be avoided or prevented. The condition of the mouth attendant on fevers accelerates decay.

The great *preventive* of decay is friction, that is, the keeping of the surfaces of the teeth swept clean of the food, mucus, &c., that tend to lodge between or about them. With this object their lingual as well as labial and buccal surfaces should be brushed night and morning; the direction of the brushing should be always from the gum, *i.e.* downwards for the upper and upwards from the lower teeth, as this removes food from between them by the natural lines of clearance; the masticating surface of the back teeth should also be brushed. Where the mucus is ropy and clings to the teeth, a saponaceous tooth powder should be used. Prevention of decay.

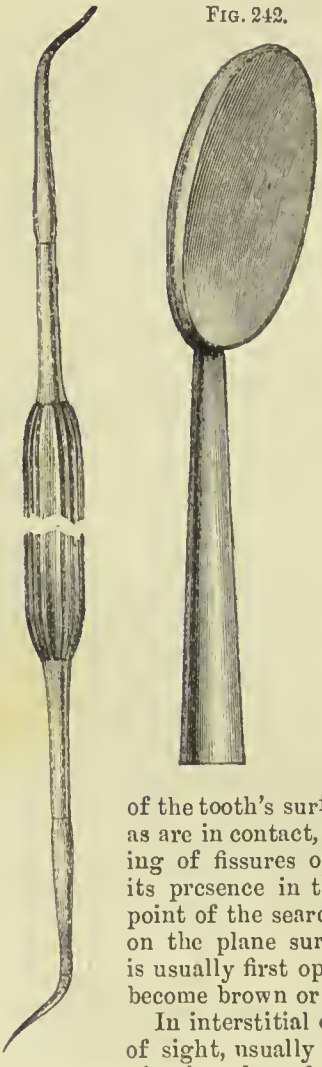
Rinsing out the mouth after meals is a practice to be generally encouraged, and the use of a weak alkaline mouth wash may with advantage be had recourse to, in order to correct undue acidity of the oral fluids, and also to neutralise the local effects of strong acid medicine.

Among preventive measures must be classed what may be termed preventive stopping. For example, a small spot of decay is often found near the distal edge (of the masticating surface) of the second temporary molar; if this be not stopped the decayed posterior surface of the tooth will come in contact with the mesial surface of the first permanent molar on its eruption, and decay be started in it; then on the shedding of the temporary molar, its successor, the second bicuspid, will have its distal surface exposed to decay from contact with that already existing in the first molar, and thus from lack of a small stopping in a temporary tooth, two permanent teeth are frequently lost or only saved by elaborate fillings.

Insidious character of.

The progress of decay is usually very insidious, a minute and unnoticed fault or fissure of the enamel often leading to extensive decay of the dentine. (See decay depicted on masticating surface of molar in D, Fig. 243.) A warning by pain is by no means always given, but sometimes a twinge or slight ache is experienced when the periphery of the dentine is reached and becomes irritated by saccharine or sapid substances or by thermal changes; if this warning is neglected, often nothing more is felt, till an acute twinge shows that the pulp is exposed, or a caving-in of the enamel reveals a large cavity. It thus happens that the detection of decay in its earlier stages can only be insured by frequent inspection of the teeth. Such inspections should begin with the first teeth and be carried out systematically several times a year if the teeth are to be preserved and much stopping avoided.

Fig. 242.



Pain a beneficent warning.

Frequent inspection recommended.

For the purpose of examination, a mouth mirror and a pointed instrument are required; the double-pointed searcher here figured (Fig. 242) is particularly useful, its curved ends being adapted to pass between the necks of the teeth; it should be employed very lightly in finding out whether a pulp is exposed.

Natural depressions favour the development of caries.

The natural fissures and all depressions of the tooth's surface, together with the sides of such teeth as are in contact, should be carefully examined. A darkening of fissures often points to decay in their depths, and its presence in them may be considered certain if the fine point of the searcher passes through to the dentine. Enamel, on the plane surface of a tooth, when affected by decay, is usually first opaque and of a chalky whiteness, but may become brown or blackened.

Decay at sides of teeth that are in contact.

In interstitial decay the defect in the enamel, being out of sight, usually escapes detection, and the first evidence of its presence is given by a darkening of the underlying dentine, which

darkening shows through the enamel, and in the case of a front tooth is first observable on the lingual or labial surface, and in the case of the back teeth usually on the masticatory surface (see Fig. 243, A). The amount of discoloration varies, sometimes a distinct black spot being visible and showing through the enamel, in other cases a smoked appearance or a slate colour being imported to the affected quarter of the tooth, the variable depth of shade being dependent on the distance from the enamel surface at which the decayed dentine lies, and also upon the character of the decay. Discoloration often the first visible sign.

In young teeth, with their deficient density, decay runs a rapid course, and the pulp, being larger, is quickly exposed. The teeth of women during the term of pregnancy are apt to decay rapidly, and to be peculiarly sensitive—a reason for having them put in good order in anticipation of that event.

Treatment of Decay.

Treatment.

To stay the progress of decay in the hard structures of the crown, two methods are practised, viz. "cutting-out" and "stopping." In either case the affected dental structures must be thoroughly removed and the cavity obliterated.

"Cutting-out" decay is accomplished by removing adjacent sound enamel and dentine, together with the diseased portion, in such a manner that there is left an even surface of hard and healthy tooth, which should be well polished. The full depth to which disease has affected the dentine should be ascertained before the adoption of this method, which should only be had recourse to in healthy mouths, and only in cases where the cut surface will be exposed to friction. Cutting-out.

Stopping consists in the removal of diseased structure, in the giving to the resulting cavity a retaining shape, and the insertion into it of a stopping which is made flush with and accurately adapted to the edges of sound surrounding tooth structure. Stopping.

In practice, cutting-away and stopping are often combined. Dentine left exposed should always be well polished, and if sensitive, camphorated spirits of wine may with advantage be applied to it daily, or it may be touched with chloride of zinc, or in the back of the mouth nitrate of silver or a spirit solution of tannin may be applied to it.

Various materials are used for stoppings. Materials used in stopping.

Gold, skilfully inserted, gives the best results when the tooth is in a condition to bear its introduction.

Amalgams (among which the so-called gold amalgam is very good) can be introduced into a cavity in a plastic state, and therefore can be packed round corners and adapted to thin walls that might not bear the pressure necessary to consolidate gold. Amalgams.

Silicated gutta percha, from its non-conduction of heat and cold, is valuable as a temporary filling, and is particularly well adapted for cavities which pass below the gum; in positions where it is not exposed to the wear of mastication it sometimes lasts for years.

"Osteo," an oxychloride of zinc stopping, has the advantage of clinging to the walls of the cavity, which consequently requires less shaping; it is also non-compressible, which, with its property of non-conduction, renders it valuable as a temporary filling where the pulp is almost or quite exposed. It will not last long if in contact with the gum, and is not to be trusted in interstitial fillings; but for stopping

large cavities on the masticating surfaces of teeth in which the pulp is almost exposed, it is a most valuable substance; and if it wears away on the surface, some of it may with advantage be left in the lower part of the cavity, while the upper part is packed with gold. A saturated solution of mastic in spirits of wine (or some such preparation) mixed with cotton wool, is serviceable as a temporary filling when a carbolic-acid dressing has to be retained in the tooth for any time not exceeding a fortnight.

Whatever stopping is used, the cavity should be kept absolutely dry while it is being filled.

The front upper teeth, which are very liable to interstitial decay, can (especially in the young) be temporarily separated by wedging them apart, thus allowing of their being filled from the side or lingual surface without interfering with their contour or leaving the stopping visible; B and C in Fig. 243 show how hidden cavities in other situations can be reached and stopped, if they cannot be got at by a gradual process of wedging.

Exposure of pulp to be avoided.

In shaping cavities for filling, the proximity of the pulp with its outstanding coruna has to be borne in mind, and its exposure avoided. (*See* Molar, in D, Fig. 243.)

If a healthy pulp is exposed in preparing a tooth for stopping, a cap of some non-conducting material, which has been moistened with carbolic acid, should be at once placed over it, and then a stopping introduced. (*See* Bicuspid, in D, Fig. 243.)

Ulcerating condition of pulp.

If an exposed pulp has become inflamed at the point of its exposure, and has taken on a secreting action, repeated dressings with carbolic acid to get rid of this ulcerating condition may be had recourse to; and if successful, a stopping may be introduced over the capped pulp; but as a rule, if the pulp has shrunk away from the aperture of exposure, or been the seat of continued pain, it cannot be preserved with comfort, and the best treatment in such a case consists in rapidly bringing about its death by the application of arsenious acid, and then, when it is devitalised, by withdrawing it and thoroughly filling the pulp chamber and its root extensions. (*See* Bicuspid, in E, Fig. 243.)

Devitalization and extirpation of pulp.

The accompanying series of drawings, A, B, C, D, E, Fig. 243, illustrate progressive disease in a tooth and its treatment.

FIG. 243.

Progressive decay illustrated, with its treatment at its several stages.

A



Represents the masticatory surfaces of second upper bicuspid and first molar. The darkening of the decay beneath shows through the enamel on the bicuspid. A searcher is introduced to explore the mesial surface of the molar for decay.

B



The same teeth; the front surface of the molar, having presented superficial decay, has been chiselled down, which gives space for stopping instruments to be brought to bear upon the deeper cavity in the bicuspid.

C



The same teeth with decay more advanced. The cavity in the front of molar, proving too deep for "cutting-out," is reached by stopping instruments introduced *viâ* the cavity in the bicuspid. The latter tooth having had the enamel on its masticatory surface too much undermined for preservation, will have its contour restored by a stopping introduced into the dovetailed-shape cavity, here seen from above.

D



Represents continuation of disease as seen in vertical section of lower bicuspid and first molar. In the bicuspid the pulp has been just exposed, but being healthy has had a carbolised cap and a non-conducting stopping placed over it, and has developed a protective shield of secondary dentine. A gold stopping is seen in the molar, of a shape that would ensure its retention if solid. Commencing decay is also shown at the masticating surface of this tooth.

E



Same teeth. The pulp of the bicuspid is supposed to have been destroyed with arsenious acid and withdrawn from the pulp chamber, which, with its extension to the end of the root, is represented as filled, the lost portion of the crown being also restored. The effects of unchecked disease are seen in the molar, the anterior root being occupied by purulent fluid, and its apex bathed with pus of an alveolar abscess. The posterior root, in which some living pulp still remains, is represented as exostosed, but might with equal truth have been depicted as covered with thickened and inflamed periodontum.

When a pulp has been extirpated immediately after its loss of vitality the root canals should be stopped to their apices forthwith, but when a dead pulp has remained in a tooth for any time a thorough purification by the use of carbolic acid must precede the stopping.

In some cases after the pulp has been extirpated, instead of filling the roots, an alternative plan must be adopted if the tooth is to be saved. This consists in drilling a fine canal beneath the free edge of the gum into the emptied and cleansed pulp chamber, which is then covered over with a cap and superjacent stopping.

Rhizodontropy.

Fig. 244.



Fig. 244 represents a tooth so treated—the gum in this case acts as a valve opposed to the ingress of food, &c. The vent (which may be made through a stopping), by preventing the accumulation of fluid or gas in the pulp chamber, stays the development or allows the subsidence of inflammatory mischief about the root.

Pivoting.

Pivoting.—When no other teeth want replacing and the crown of one of either of the six upper front teeth is lost through fracture or decay, the operation of pivoting a new one on to the root is much to be preferred to other modes of attachment.

Fig. 245.



The ordinary operation.

In the case of a healthy root the crown can with advantage be pivoted on it once for all, after the end of the canal has been filled with gold or other durable stopping; but in other cases the following mode of operating is to be preferred:—The canal at the end of the root is left open, and the new crown is affixed to the root by a split gold pin which is sheathed in a platinum tube fixed with stopping into the rifled barrel of the root. Here the tooth crown can be removed and replaced at pleasure, while the root is preserved from further decay by being lined with metal, and by this method a root not fully formed, or one that is the subject of alveolar abscess, may safely be used for supporting a pivoted crown. (See Fig. 245.)

Pivoting with vent.

Decay at its commencement is, as a rule, capable of satisfactory and quite or comparatively painless treatment. The difficulties of its successful treatment increase with its onward progress, while the nerve complications that have been noticed, and the severe inflammatory lesions which will be enumerated further on, are most frequently the sequelæ of neglected decay.

Fracture of Teeth.

Fracture of teeth.

Teeth, especially projecting upper incisors, are liable to be fractured. If only a small portion of the crown is chipped off, the fractured edge may be smoothed with a file or stone and touched with spirit to keep it hard and insensitive (filing to amend shape should not be had recourse to while the patient is very young). If the portion broken off is so large that the tooth will be permanently disfigured and yet the pulp has escaped destructive irritation, the tooth may for a time be left as it is, or the remainder of the crown may be removed and a new crown pivoted on to the root; in a young subject the destruction of the pulp preparatory to pivoting should be postponed until it is reduced to its ultimate tenuity by the perfecting of the root.

Treatment according to extent of.

If it is evident that the pulp has become inflamed through the fracture it will be desirable to at once destroy and extirpate it, in order that the periodontum may be preserved in a healthy condition, and therefore the root be in a position to carry a pivoted crown with

comfort. In young subjects, when the teeth are much crowded and relatively prominent as compared with those in the lower jaw, it may be desirable to extract the fractured tooth and to train-in the neighbouring teeth to occupy its site.

Arrested decay.

Arrested or carbonised decay.—Sometimes in young subjects when the enamel is lost almost simultaneously over the whole masticating surface of a molar tooth, decay becomes arrested, the exposed dentine assuming a dark mahogany or black colour, and presenting a density which qualifies it for mastication. Such a result may be aided by the rounding-off of projecting enamel edges.

Erosion.

Erosion.—Occasionally the enamel and subjacent dentine are gradually lost by a process which was called by Hunter "decay by denudation," and by recent writers erosion. The surface of the cavity so formed remains hard and polished and often free from discoloration. It is probable that this gradual wasting away of the tooth substance, without any of the ordinary appearances of caries, is due to the combined action of chemical solution and friction; the enamel in the first instance being affected over a comparatively large area, the dentine, when reached, is exposed to friction which prevents its softening.

This erosion may affect other parts of a tooth, but usually attacks the labial surface at the neck; frequently many teeth in the same mouth are affected by it, a groove being gradually scooped in the teeth just above the gum until the pulp is exposed.

Treatment.

TREATMENT.—An alkaline mouth wash should be prescribed; horizontal brushing interdicted, and if the exposed dentine is sensitive either of the solutions mentioned at page 577 may be applied to it. In cases admitting of it, stopping should be had recourse to, that the pulp may be preserved from exposure.

Affections of the Pulp.

The dental pulp.

An exposed dentinal pulp is subject to mechanical, thermal, and other irritation. The pain produced by such irritation is of a sharp lancinating character, sometimes passing away with an ache.

Its various diseased conditions.

Chronic inflammation.—Circumscribed superficial inflammation with increase of sensitiveness may be developed in the pulp at the point of exposure, and may continue for a long time in an unsuspected cavity, giving rise to reflex pain or (so-called) neuralgia.

Ulcerative condition.—The exposed surface of the pulp may take on a secretive action, and the tooth be free from pain as long as the exuded sero-purulent fluid finds an exit, and the pulp escapes fresh irritation.

Acute or general inflammation of the pulp is attended by terrible pain of a violent throbbing character, which, after lasting several hours or days, may cease as suddenly as it began, its cessation betokening the death of the pulp. In this case every factor for the production of agonising pain is present, the distensible pulp, largely supplied with nerves, undergoing vascular engorgement within an unyielding case (closed-in at all parts except at the aperture of exposure, through which it may bulge and suffer further constriction). The pain is not usually confined to the faulty tooth, but spreads from it to the neighbouring teeth and to the side of the face; during the paroxysms the tooth often becomes tender to pressure, owing to a sympathetic irritation of the periodontal membrane. Prompt measures

shonld be taken to prevent the products of decomposition which result from the sphaeclus of the pulp from passing beyond the interior of the tooth and so causing the inflammatory involvement of the periosteum and the formation of alveolar abscess. The pulp occasionally loses its vitality without producing noticeable pain.

Tardy destruction of the pulp.—Instead of losing its vitality at once the pulp may die piecemeal, the chronic irritation that attends this process being often productive of morbid changes on the exterior of the root. A pulp chamber that contains the remains of a decomposed pulp emits a strong and peculiar phosphatic smell.

Calcification of pulp has been described already under the head of *Secondary dentine.*

Hypertrophy of.

An insensitive polypoid growth of the pulp, consisting of granulations which throw off a secretion and readily bleed, sometimes projects from the pulp chamber into a cavity in the crown of a tooth; it usually necessitates the extraction of the tooth on account of the successful resistance it offers to extirpation.

A sensitive sprouting of the pulp may follow fracture of a tooth. Extraction would be the treatment for this condition, which, by extirpation of the pulp, should be prevented from developing, if the retention of the root is desirable.

Necrosis of pulp from blow, &c.

Necrosis of the pulp may occur within the unopened pulp chamber of a sound tooth. It is most often consequent on a blow (sometimes a very slight one) rupturing its vessels as they enter the apex of the root. It may supervene on fever. A darkening of the whole tooth results, and is due to the permeation of the dentine by the decomposed colouring matter of the blood.

Salter has pointed out that the pulp thus devitalised may be disposed of by fatty degeneration. In the absence of treatment (*i.e.* extirpation of the pulp, &c.) it often leads to alveolar abscess.

A tooth knocked out and immediately replaced may become quite firm and obtain vital connection with the alveolo-dental membrane, and will then be in the same condition as the above. Death of the pulp will be evidenced by the absence of sensation in a tooth when touched with an instrument hot enough to evoke sensation in its neighbours.

Affections of the Alveolo-dental Membrane.

Periodontitis.

Dental periostitis may be local or general, chronic or acute.

General inflammation of the periosteal investment of the teeth and their sockets results from rheumatism or attends on a debilitated or unhealthy condition of the system, and demands constitutional treatment. When slight in amount and causing only a loosening of and sense of fulness and uneasiness about the teeth, no local treatment may be required beyond the use of a slightly astringent mouth wash. When the gums are also congested they should be scarified and a stronger astringent (tannin dissolved in spirits of wine is efficient) applied to them. Tincture of iodine is a favorite application with some. Any root or tooth that may be an excitant of inflammation is best removed, and tartar should be thoroughly got rid of from beneath the free edges of the gum.

Constitutional forms of. Treatment.

The continuance or oft-repeated recurrence of a congested condition of gum and periodontum leads to the absorption of the alveolar edge and consequent loss of implantation for the teeth; the gradual deposi-

tion of tartar upon the root, besides being one of the commonest causes of this condition, is apt to attend upon and increase it when arising from other causes. When the periosteal inflammation is more acute and pus is formed about the necks of the teeth, a solution of chloride of zinc—8 grs. to the ounce—will be found a beneficial mouth wash and will correct fœtor.

The general symptoms of dental periostitis have been given at page 571; it may be added that when due to rheumatism, toothache is apt to be present and swelling and suppuration absent, and that it will often subside of itself, while in a scrofulous subject, or when due to syphilis, the pain is often slight and the tendency to suppurative inflammation marked, and that in these cases the loss of the teeth is imminent and that their extraction at once may be desirable. Periostitis of the alveolar process of the jaw, leading to necrosis, may be caused by syphilis, coughing of the gums, or alveolar abscess, or may have a traumatic origin.

Phosphorus necrosis.

The fumes of phosphorus, productive of "phosphorus necrosis," probably find a readier ingress when the pulp of a tooth is exposed, and other irritants productive of periosteal inflammation may act through the same channel.

Necrosis following the exanthemata.

Necrosis of the alveolar portion of the jaw in children may follow either of the exanthemata, and will not always lead to the loss of the permanent teeth if due time is given for the separation of the necrosed portion.

Inflammation of a subacute type may attack the periodontum of one tooth after another and lead to their successive loss in cases where the roots of the teeth are exposed through the recedence of the gums and alveolar margin from senile absorption or other causes.

Local periodontitis.

Local Dental Periostitis.—With the exception of the condition just named, inflammation attacking the alveolo-dental membrane of a single tooth results from pre-existing disease in the tooth or is due to some local cause of irritation, such as a ligature applied carelessly for regulating purposes or for fracture of the jaw, the accumulation of tartar, or the undue and oblique pressure of an antagonist tooth. Chronic inflammation and thickening of the periodontum is often complicated either as cause or effect with exostosis or with a very small chronic alveolar abscess about the apex of a stump, and is, in these cases, associated sometimes with severe neuralgia, the pain simulating that of tic-douloureux.

Dental cysts.

The Dental Cysts which sometimes form on the roots of teeth are probably generally the outcome of conditions which in their more sthenic form lead to the formation of alveolar abscess. An alveolar abscess may pass into a cystic condition, and it is certain that these cysts (which may contain cholterine) may suppurate, and then to all intents and purposes they become converted into alveolar abscesses.

Alveolar abscess.

Periodontal inflammation of an acute form, producing **Alveolar Abscess**, is the natural sequel of death of the pulp, the products of the decomposition of its structure passing through the foramen at the end of the root, giving rise to it. Pus formed between the root and its investing membrane may separate the latter from the former and escape around the neck of the tooth, in which case, if the dentinal pulp is also dead, the tooth becomes absolutely necrosed and is to be regarded as a foreign body. Pus may become diffused beneath the

Its formation.

gum, and this is especially likely to occur in the case of lower impacted wisdom teeth. Far more commonly, pus, derived from the pulp chamber or due to the breaking-down of inflammatory lymph, which has been thrown out about the apex of the fang, is contained in a circumscribed abscess which embraces the end of the root (*see* Fig. 243, E) and occupies an excavation in the maxilla.

Preventive treatment.

Preventive treatment consists in the complete clearing-out of the root canals and their thorough purification with carbolic acid, this, with the administration of a saline purgative and the local abstraction of blood by the application of a leech to the gum over the root, affords the best chance of cutting short periodontal inflammation that tends to the formation of abscess.

Symptoms.

The formation of an alveolar abscess is usually preceded by great local tenderness to pressure on or over the root of the tooth, and attended by pain of a throbbing character, sometimes by rigors and considerable constitutional disturbance.

A possible cause of pyæmia.

The possible occurrence of pyæmia from this cause is not to be overlooked. Great serous effusion into the cancellated bone and the soft surrounding tissues not infrequently takes place, mistaken sometimes for erysipelas and occasionally resulting in suppuration; the closure of the eye of the affected side, or a swelling from the lower jaw reaching half down the neck may thus be produced. An abscess connected with an upper molar sometimes causes a fulness over the lower jaw. When an abscess is formed the contained pus tends to find an exit either through a gumboil (so-called), or by a fistulous opening on the face, &c.; an opening on the gum being naturally formed when the mucous membrane is reflected from gum to cheek at a distance from the alveolar border, and a canal through the body of the bone, if the root of the tooth extends below such reflection of the mucous membrane.

Gumboil.

An alveolar abscess attached to the upper teeth may perforate the antrum, when attached to an incisor may open into the nares, or when connected with a lateral incisor may pass backwards between the compact layers of the palatine process of the superior maxilla or between the periosteum and the hard palate, and open through or behind the soft palate.

Fistulous openings on face, &c.

It may also form fistulous openings on the face near the inner canthus or under the edge of the malar bone. An alveolar abscess connected with lower incisors may open under or in front of the chin, and above or under the margin of the jaw when connected with the other lower teeth; from a wisdom tooth the pus may pass forwards to the canine, backwards to the fauces, or escape at the angle of the jaw. Pus from an alveolar abscess may pass down the neck, and in one case it found final exit below the clavicle, and in another and fatal case it reached the armpit.

The pus of an alveolar abscess that distends the mucous membrane of the gum or cheek should of course be evacuated by an incision, if the extraction of the tooth does not suffice for the purpose. A chronic gumboil may be regarded as a safety vent; but abscess with such a fistulous opening on the gum may sometimes be cured by pumping carbolic acid through the root of the tooth until it escapes on the gum, followed-up by stopping of the root.

Treatment of alveolar abscess.

When alveolar abscess has formed and does not tend to open on the gum, but causes a distension of the bone over it, together with local inflammation, the tooth, as a rule, should be extracted without delay to prevent further mischief, although in some cases a clring out of the

pulp chamber and the performance of rhizodontropy, coupled or not with a direct opening into the abscess to evacuate the pus, may be the right practice.

In alveolar abscess of the lower jaw, a promiuence passing out from any diseased tooth aud obliterating the natural sulcus between gum and cheek will point to the tooth which should be extracted, and a vertical incision across the abscess track within the mouth may be advisable to prevent the next step in the formation of an external fistulous opeuing, namely, the distension and thinning of the skin preparatory to its perforation. In these cases warm water should be held in the mouth, aud poultices should *not* be applied to the outside of the face.

A fistulous opening on the face, which has given exit to a coutinual discharge for years, will at once close up on the extraction of the tooth or buried root which has caused it, but a permanent depressed cicatrix will be left; in these cases a probe introduced from the outside will very likely impinge on something which feels rough and hard like dead bone, but is really an exostosed and roughened tooth fang; absence of fœtor in the discharge and singleness of the opening point to the presence of a diseased tooth and not bone disease. Diagnosis.

Serious local Complications of Inflammatory Action set up by Tooth Disease.

The disfigurement of a fistulous opening on the face, due to neglected alveolar abscess, is comparatively common, but far more severe complications are sometimes but very rarely produced by the inflammatory involvement of surrounding structures. The seventh nerve has thus been involved, producing facial paralysis. Necrosis of the involved bone has led to a fatal result. Several cases are detailed by Salter in which permanent loss of sight in one eye followed antral abscess or inflammation about the upper teeth. In one case amaurosis of thirteen months' duration was got rid of by the extraction of a carious tooth from the end of which a splinter of wood projected. In the case of a patient who recently came with symptoms of tumour in the orbit into Guy's and there died, Dr. Goodhart traced the origin of mischief to caries of the first left lower molar, which gave rise to abscess, suppuration in the inferior dental canal, acute ostitis of left side of lower jaw, extension of disease by pterygo-maxillary fossa to orbit, suppuration in both orbits, ostitis of vault of skull, and pyæmia. Case of dental caries resulting in death.

The spasm of the masseter which frequently attends disease about the lower back teeth is sometimes probably due to inflammatory involvement of the nerve, and not simply to reflex irritation. Extraction of the tooth is its cure, and the mouth may be opened sufficiently to allow of this being accomplished by the persevering use of a wedge between the teeth.

Tartar or salivary calculus consists of lime salts precipitated from the oral fluids, together with "leptothrix buccalis," epithelial scales, &c.; it especially tends to form on the lingual surface of the lower front teeth, and on the buccal surface of upper molars; a small rim may be often found on all the teeth under the free edges of the gum, which may then present a narrow blue line or be generally congested. Brushing in the manner recommended for the prevention of decay checks its deposition. Its presence in large mass may cause ulceration Salivary calculus.

of the tongue, &c., and in much smaller quantity causes loosening, and if allowed to accumulate, the loss of the teeth. It should be carefully and thoroughly removed with small scaling instruments, used so as not to make the gum bleed.

All teeth that are retained in the mouth should by stopping and scaling be rendered as sound and firm as possible. A patient with tartar-loaded and decaying teeth may travel for fresh air, but will hardly find it.

Epithelioma set up by jagged points of teeth.

All sharp and jagged edges of teeth should be removed by a file; this is of special importance in after-life, as localisation of epithelioma of the tongue is commonly traceable to irritation so produced.

Tumours and other Affections of the Gums.

The gums.

Sundry gum affections are intimately connected with the teeth.

Hypertrophy of.

Simple hypertrophy of the gums, chiefly on their labial surface, is sometimes met with when the teeth are overcrowded, the gum being shut out, as it were, from between the necks of the teeth. The preventive treatment for this condition is self-evident, but when it is established, and extraction is inadmissible, it may be reduced by free scarification and the application of tannin, &c.

Occasionally, in unhealthy subjects, hypertrophy assumes larger proportions, the crowns of the teeth being buried in lobulated masses of gum. The treatment consists of scaling, free scarification (and sometimes excision), together with the local use of astringents and fœtor-correcting applications. Absorption of the underlying alveolus, and consequent loss of implantation for the teeth, is apt to attend upon this hypertrophy, as it does upon continued extra vascularity of the gums.

Polypus of.

A polypus of the gum is frequently found to project into dental carious cavities which extend below the gum; it is vascular and insensitive, and should be cut away and packed out of the tooth cavity preparatory to the filling of this latter. This gum polypus is sometimes liable to be mistaken for polypus of the dentinal pulp.

Epulis.

Its connections.

Epulis.—The tumours classed under this name present, in varying proportions, a fibrous or myeloid character, and not infrequently have small osseous development at their bases. As regards the maxillæ, these growths essentially belong to the alveolar or tooth-bearing portion, and consequently can, as a rule, be completely removed without interference with the basal portion of the bone. The fibrous tissue of the gum, the endosteum, and the alveolo-dental membrane having continuity, may each share in the development of an epulis; it therefore follows that for the complete eradication of the disease, the extraction of an adjoining tooth or root may be demanded, together with the excision of the growth and involved bone.

Vascular tumours.

Vascular tumours.

My colleague Mr. Salter has recorded a case of a vascular tumour, the size and colour of a Morello cherry, which he found attached by a narrow neck to the periosteum of a tooth. In my own practice a lobulated tumour, of polypus character, and having much the appearance of an epulis, overlapped the hard palate, and was found to be attached by an exceedingly narrow pedicle to the edge of the periosteum of a decayed molar tooth. In both these cases hæmorrhage of a really alarming extent had occurred, and in both the tumour was removed by extracting the tooth.

The painful "ulcerative stomatitis," so frequently met with in hospital practice among young children, often demands the extraction of loosened and irritating teeth, coupled with the internal administration of its specific remedy, "chlorate of potash." Ulcerative stomatitis.

The Extraction of Teeth.

Speaking generally, extraction may be required for regulation of teeth, which includes the prevention of overcrowding. To prevent or get red of impaction of a wisdom or other tooth. For neuralgia and nerve irritation when its origin in a tooth is not confined to some condition of the pulp which can otherwise be got rid of. As a rule, in cases where periodontitis (not rheumatic) is established and resists curative treatment. When an alveolar abscess tends towards opening externally. In cases of vertical fracture of the tooth. In the case of loose and diseased teeth or roots which keep up an unhealthy condition of the mouth. When an epulis has probable connection with alveolo-dental membrane. And, finally, in some cases to allow of more satisfactory artificial restoration. Extraction, when required.

Forceps and Elevators are the instruments now used for the extraction of teeth. The forceps adapted for the removal of the different teeth will be found described in 'Tomes's Dental Surgery,' and only a few special points will he here noticed with regard to them and their use. Forceps should be finely made and well tempered, with blades which should grasp the tooth's neck without pressing on the crown, as extraction is seldom required for sound teeth, but for those that are broken down or hollowed out by decay. Instruments for.

In extracting a tooth the forceps should be applied lightly but closely to its neck and then sent firmly up (or down, as the case may be) until they grasp a part of the tooth that will resist some pressure; the edges of the blades will thus, as a rule, be made to pass just within the edges of the socket, while in the case of the molars the points of the blades will take grip at the bifurcation of the roots; the right hold being obtained by this first movement, the instrument is thenceforth kept at one with the tooth, which is first separated by a particular movement from its socket attachments and then withdrawn.

The accompanying drawing, Fig. 246, shows the manner of holding forceps. The little finger may be used as a kind of opening spring, and the thumb should act as a stop between the handles and prevent any crushing pressure. Manner of holding forceps.

Fig. 246.



Manner of holding forceps.

The particular movement required for the dislodgment of a tooth depends on the shape of its root. Thus, the upper incisors and canines, together with the lower bicuspids, are more or less conical, and are therefore to be rotated, while the lower incisors and canines, together with the upper biscupids, are more or less flattened from side to side, and therefore are to be moved outwards and inwards. The molar teeth are also to be moved outwards and inwards before being extracted. Particular movements required to dislodge the several teeth.

Direction in which they are withdrawn.

The direction in which teeth are withdrawn from their sockets depends on the position held by their roots. Upper molars are extracted downwards and outwards; lower molars upwards, and often somewhat backwards; while in order to follow the curves of their respective roots, upper wisdoms should be extracted downwards, backwards, and outwards, while the crowns of lower wisdom teeth should be carried backwards and upwards.

An elevator should not be used in extracting the upper wisdom tooth on account of the fragile nature of the tuberosity of the maxilla in which it is lodged, but may sometimes be used with advantage for a lower wisdom when the second molar is sound and firmly implanted.

Of impacted lower wisdom.

Before attempting to extract a buried and impacted lower wisdom tooth a careful examination should be made with a probe to see how

Fig. 247.

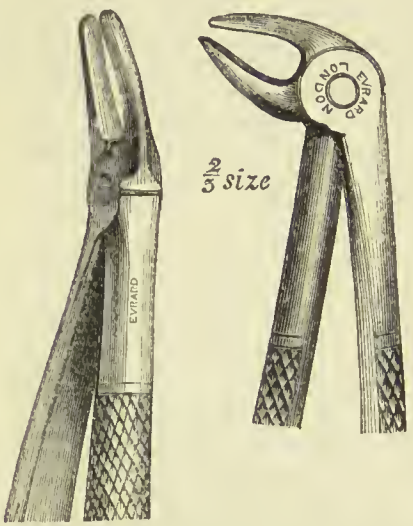


Fig. 247.—A. Upper stump forceps. B. Lower stump forceps.

Fig. 248.

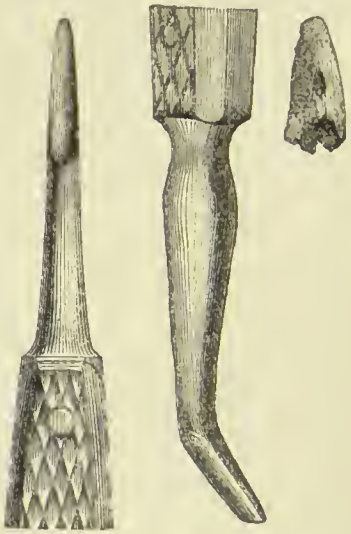


Fig. 248.—Wedge-shaped scoop elevators, which are very useful in extracting buried or much hollowed-out roots, such as C. A. Elevator for upper roots. B. One of a pair of elevators, devised by Mr. C. Rogers, for lower stumps. Such a root as C may sometimes be best removed from the upper jaw with an instrument having a spiral cut on it, used like a corkscrew.

it is situated; sometimes it will be found to hold a horizontal position, its crown impinging upon and causing absorption of the root of the second molar. In cases where it is possible to extract the impacted tooth, lower hawksbill stump forceps with a double curve and an elevator such as shown in Fig. 248, B, will be found very useful. In cases where the ascending ramus would be necessarily injured in attempts to remove the wisdom, the second molar should be extracted and then the buried tooth may erupt without further trouble, or can be easily removed if still a source of irritation. Stump forceps, as here figured (Fig. 247), are far better adapted for the extraction of

Of bicuspids.

bicuspids than the so-called bicuspid forceps.

In the case of a much broken-down or hollowed-out lower molar, instead of using molar forceps, it is better to grasp with stump forceps the one of the two roots which offers the best hold, and if the union between the roots is not strong enough to allow of their withdrawal together, the remaining separate root will be easily removed. Use of stump forceps for extracting united roots.

The three undivided roots of a crownless upper molar may be extracted with "Coleman's forceps," or with long flat-bladed, loose-jointed stump forceps as made by Collins.

Occasionally dividing forceps may be used with advantage in extracting united roots of either upper or lower molars.

When a root is partially covered over with gum the position of its edges should be defined with a probe before any attempt is made to grasp it. Use of searcher.

With well-made forceps, lancing the gums before extraction is usually unnecessary, but sometimes, especially in isolated teeth, the gum is strongly adherent to the tooth and is apt to be torn away with it if not first separated. Lancing previous to extraction.

Fistulous openings on the face are seldom seen in connection with children's temporary teeth, but the external alveolar plate is often perforated, and the end of a root projects through and causes ulceration, which may lead to adhesion between gum and cheek; the teeth causing this irritation are easily pushed out with an elevator.

Persistent hæmorrhage following the extraction of a tooth and resisting cold may be stayed by tightly packing the socket with rolls of softened matico leaf (Tomes), or with a strip of lint cut to a point and dipped in a spirit solution of tannin, a compress being placed over and kept in place by the opposite teeth. At the same time astringents or iron should be given internally if the hæmorrhagic diathesis exists, or appropriate measures be taken if the bleeding in the case of a woman appears to be vicarious. Hæmorrhage after extraction. Its treatment.

When natural teeth are lost, artificial ones unquestionably conduce to comfort and health. Artificial teeth.

In elderly people teeth that project in an unsightly manner can often be shortened with much advantage and without pain. The roots of upper front teeth and of lower teeth, if healthy, may often be retained in the mouth with gain. The wholesale and indiscriminate extraction of teeth is to be strongly reprobated, leading, as it does, to premature absorption of the alveolar processes, and thus often reducing in middle age the lower jaw to a level with the root of the tongue, and, therefore, ill-fitted to support artificial teeth. Several painful cases resulting from extreme absorption, due to this practice, have lately been seen by me.

In the cases of cleft or perforate palate which are not amenable to surgical treatment, artificial restoration should be had recourse to. Obturators and soft palates.

An obturator should only span the orifice in recent cases of perforation, in order that occlusion by the approximation of the edges of the opening may not be interfered with, and in no case should a method of fixing in the plate be used that will tend to enlarge the aperture.

AFFECTIONS OF THE PHARYNX AND ŒSOPHAGUS.

Inflammation and Suppuration of the Pharynx

Inflammation of pharynx.

is met with in the feeble and cachectic subject, and comes on with general and local symptoms not unlike those of quinsey, both affections being often associated. Pain with difficulty in swallowing is the chief local, while fever with constitutional disturbance is the chief general symptom.

Abscess of pharynx.

Abscess may be the result of an acute or chronic inflammation of the part, and shows itself by some bulging or projection of the mucous covering of the pharynx. It may be so large as to interfere with if not prevent deglutition, or even to impede respiration. I have seen this occur twice in cases of spinal disease. When these conditions exist, the abscess must be opened, the best instrument to use being a straight bistoury protected up to the point by a piece of lint or strapping. An instrument called a pharyngotome has been devised for the purpose, and answers well, but the bistoury is preferable. Tonics, such as quinine, iron, or the mineral acids, are almost always required in these cases. Steaming the throat gives great comfort, as well as external warm applications. Nutritious food should always be allowed. The surgeon should remember that a post-pharyngeal abscess may be due to disease of the vertebræ or base of the skull, but such cases are generally chronic.

Tumours of pharynx.

Tumours of the pharynx may also give rise to the external appearances of a chronic abscess by pressing the mucous membrane forward, and cancerous tumours are very liable to do this. One of the most marked cases of the kind I ever saw turned out to be a syphilitic gummatous tumour which was so large as to make me suspect its cancerous nature, but, on investigation it proved to be syphilitic, and was cured by ten-grain doses of the iodide of potassium in bark three times a day.

The cancerous tumours generally commence in the upper part of the pharynx, and cause obstruction of the posterior nares; as they grow downwards they simulate a pharyngeal polypus. Two such cases in young people have been under my care, and both died. It was a question in both whether the disease was not originally in the tonsil, but it appeared to have originated above the gland.

Dysphagia

Dysphagia is only a symptom.

is merely a symptom, and due to numberless conditions, which cannot be treated till the cause is known. To ascertain this is consequently most important, and should always be done by eliminating every possible cause. It may be that the symptom arises from some want of

Its causes.

power in the pharyngeal muscles or from œsophageal *ulceration* or obstruction. If the former cause holds, the condition may be due to a paralysis of the muscles of the part from cerebral disease, to hysteria, or to diphtheria—as under all these circumstances there may be a more or less complete loss of power in the act of swallowing—food or fluid passing into the nose or the larynx producing suffocation. This condition

is often present after the operation of tracheotomy for croup, the want of adaptive power in the muscles of deglutition allowing liquid food to travel down the larynx and appear at the external tracheal wound. Laryngeal and pharyngeal tumours and tumours about the base of the tongue, can also produce the same symptoms.

When due to œsophageal obstruction.

When dysphagia is due to œsophageal obstruction, it may arise from spasmodic or organic stricture of the tube itself, or, to the presence of cancerous, syphilitic, or simple ulceration; when to pressure from without, to some thoracic, cervical, or aneurismal tumour, or to the presence of a foreign body in the tube.

Stricture of the œsophagus. Varieties.

Stricture of the œsophagus, as a rule, takes place at its upper end behind the cricoid cartilage, though it may also occur at other parts. It may be *spasmodic* or hysterical, but more frequently is associated with some kind of *ulcerative* action, simple, syphilitic or cancerous. occasionally it is *cicatricial*, the result of a former injury, such as the swallowing of a corrosive fluid. In the majority of cases, however, the disease is due to cancer. It is a great question whether a simple fibrous stricture of the œsophagus, such as is found in the urethra, ever takes place. *Thoracic aneurism* is capable of producing every symptom of this affection.

Spasmodic stricture.

Spasmodic or hysterical stricture is usually met with in the young, but it may be found at all ages. Paget has described it as a kind of stammering of the muscles. It is probably always associated with some local irritation, follicular inflammation or ulceration. This may have originated by itself, or been caused by an injury such as a scratch from the passage of a hard or sharp body. It is, moreover, usually associated with dysphagia. The dysphagia is likewise intermittent and uncertain; as when a patient is given food or fluid to test her power, it will be said that it is impossible to do what is required, and should it be attempted to a certainty the sufferer may half choke. Yet, at other times when otherwise engaged, food can be taken. If a probang be used to examine the part, its introduction will be violently opposed by the pharyngeal muscles, though with a little steady pressure, all obstruction will be overcome.

Œsophageal Obstruction.

Œsophageal obstruction.

When a patient complains of difficulty in swallowing, or rather of difficulty in passing food onwards down the œsophagus after the act of swallowing has been performed, and of its subsequent return into the mouth, the surgeon in looking for its cause should first think of thoracic aneurism, then of cancer of some portion of the tube, and, lastly, of simple ulceration. He should also always inquire into the history of the case, and satisfy himself that in no previous period has the patient sustained any local injury from the swallowing of boiling water or corrosive fluid. If the last cause be eliminated, and a careful examination of the chest with other modes of investigation dispose of the question of aneurism, then that of cancer becomes the most important, as there is little doubt, that such, in the majority of cases of organic stricture of the œsophagus, is the true cause. In the early stages of the affection, the diagnosis is difficult, indeed at this period, the surgeon is seldom consulted, for so long as solid food passes, the patient is hardly aware of any obstruction existing as the habit of swallowing

May be due to aneurism, cancer, or ulceration.

Means of diagnosis.

Difficult in early stage.

small boluses of food grows *pari passu* with the obstruction. An attack of spasm is perhaps the first symptom that attracts notice, spasm which completely closes the canal, and causes *regurgitation* of the food.

Signs of ulceration.

At this early period of the disease the surgeon will probably be able to pass a probang, though it may be only a small one. As the disease progresses some signs of ulcerative action may appear, such as the discharge of pus or blood, which usually comes up with the regurgitated food, and when this occurs there is no better indication of the presence of ulcerative action. If the patient be middle aged, the probabilities of the disease being of a cancerous nature are very strong, and should there be any local thickening behind the larynx or glandular enlargement, these probabilities are enhanced. When, however, the patient is a young adult, and a history of syphilis exists, its syphilitic nature is rendered probable, as simple or syphilitic ulceration of the œsophagus is sufficient of itself to cause complete œsophageal obstruction, simulating stricture—the spasmodic contraction of the muscles of the tube having much to do in bringing about this result. The following case, which occurred in a patient of Dr. Habershon's, illustrates these points very forcibly:—The patient, æt. 48, was dying from starvation caused by inability to swallow on account of œsophageal disease, and for it I performed the operation of gastrostomy. The man lived six days afterwards, and died of pneumonia. After death, nearly a complete ring of ulceration was found at the upper part of the œsophagus, which had caused all his symptoms. Its syphilitic nature could not be decided, although the man gave a history of having had the disease twenty years previously. The repair at the seat of operation was most complete, the stomach and integuments having firmly united. No peritonitis existed.

Cancerous variety.

Syphilitic variety.

Example.

Gastrostomy.

I once saw, in consultation with Mr. Pink, of Greenwich, and Dr. Wilks, a case of complete œsophageal obstruction which we all believed to be cancerous, but which so far improved under the expectant treatment as to allow of the passage of well-minced food with comparative comfort. Several months later, however, complete dysphagia returned, and the man died, a direct communication having taken place between the œsophagus and the respiratory tract from extension of the cancerous ulceration. Had a bougie been passed in this case, a fatal result would probably as a consequence have taken place.

Ulceration extending into air-tube.

Caution in use of probang.

As the disease progresses other symptoms will appear, for the ulcer may eat its way into the larynx or trachea, when it soon proves fatal. It is from this fact that the surgeon should always be very chary of passing any bougie down the œsophagus, because when ulceration has taken place, he will be very liable to do harm, and may cause perforation of the ulcer into the air-passages, or even the pleura.

Treatment by dilatation.

Useful in the cicatricial stricture.

TREATMENT.—Assuming the pathology of stricture of the œsophagus which has been given to be correct, the treatment by dilatation, is not only useless but dangerous *except* when the stricture is of *the cicatricial form;* for when it is due to cancerous or other ulceration the irritation of a bougie must do harm, and the passage of an instrument is likely to hasten the fatal termination of the disease. In the cicatricial form, however, or that which follows some local injury, such as can be produced by an irritant fluid, dilatation is of great value, and such treatment if it does not cure the disease will at least prolong life. A bougie as large as can

be passed should be introduced daily, and retained. The patient should, when possible, take solid food finely minced, and when otherwise, fluid nourishment. Milk can often be drunk when other food is refused. Beef tea is always useful, and Hassall's flour of meat mixed with it is an excellent additiou. Brand's liquid essence of meat is also invaluable. Diet.

Wheu swallowing becomes impossible, the cautious passage of a fine tube through the stricture for the introductiou of liquid food may be undertaken, though this proceeding is hazardous, and can rarely be repeated for many days. Nutritious enemata appear to me to be preferable, beef tea thickened with flour or arrowroot, with milk and egg, or a mixture of a pound of minced beef and one third of a pound of fresh pancreas, one half of which being introduced into the rectum night aud moruing, administered every four hours alternately, tending more than anything else to keep up the powers of the patient. When all these meaus fail, or rather before—for it is known that life cannot be very long maintained under such circumstances—the qnestion of opening the stomach by an operation must be entertained. Enemata. Gastrostomy.

Billroth recently has cut down upon the œsophagus and excised the cancerous growth, but without success—the operation, however, is only commended to our consideration by the eminence of the surgeon who performed it.

Foreign Bodies

are occasionally arrested in the pharynx, and, when pointed, may become fixed in the soft parts about the base of the tongue, or between the pillars of the fauces; but when bulky and solid, they are generally arrested at the narrowest portion of the tube, its lowest portion, behind the cricoid cartilage, or at the cardia. The discomfort caused by this accident is at times very great, and difficulty in swallowing, pain, and the disposition to vomit are common symptoms. A pricking sensation in the part is generally present when the substance is pointed, although it must be remembered that this symptom often remains after the substance has been dislodged. Where the epiglottis or upper orifice of the larynx is irritated, cough and other laryngeal symptoms will be produced, and the same may be said when a solid body becomes impacted behind the larynx; the larynx under these circumstances being either so compressed as to cause suffocation, or so irritated as to give rise to spasm, either of these causes being sufficient to produce death. Foreign bodies in pharynx. Symptoms.

When small bodies lodge in the part, they may give rise to inflammation and abscesses in the pharyux and neck; indeed, instances are on record in which disease of the cervical vertebræ has been the result. Coins may be impacted in the pharyux for many months, and Dr. O. Ward relates a case ('Path. Trans.,' 1848-9) in which a halfpenny was so placed for eight months, the child at last, in a fit of coughing, bringing it up. May cause abscess. May be impacted.

Treatment.—Whenever a foreign body, large or small, is suspected to have become lodged in the pharynx, a surgical exploratiou of the mouth, base of the tongue, and fauces should be made, and by carefully sweeping these parts with the index finger any foreign body will be detected. By this proceeding the foreign body may be dislodged. When any body is fixed in a part, it may be removed by forceps, the ordinary dressing forceps, as a rule, sufficing; when the body is lower down the revolving œsophageal forceps, as made for me by Mr. Krohne, Treatment. Exploration. Use of forceps.

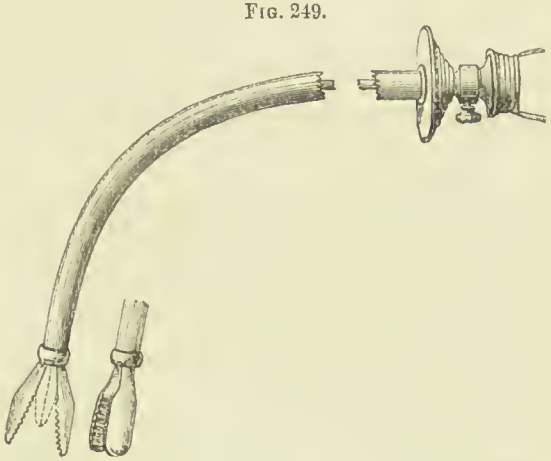
of Duke Street, Manchester Square (Fig. 249), may be used. When a coin has been swallowed by a child, and become impacted in the pharynx, the child should be laid across a pillow upon his belly on a table, with the head hanging over the end, and supported. The surgeon should then introduce his finger into the mouth and depress the child's tongue, the coin by this manœuvre sliding out of its place.

Laryngotomy.

Force never to be used in pushing body down.

When a solid mass has become impacted in the lower part of the pharynx behind the cricoid cartilage and the finger cannot dislodge it, no forcible attempt should be made to push it down into the stomach, although laryngotomy may be called for to preserve life. If a second attempt to move the impacted body fail, it is well to desist, as by the lapse of time the spasm which existed when the first attempt failed may disappear, and a renewed effort may be crowned with success. Soft bodies likewise become softer, and consequently can be the better removed or pushed downwards. A good deal may, however, be done by digital manipulation, both inside and outside the mouth, either to dislodge the foreign body or to so alter its shape by squeezing as to enable it to pass downwards. The laryngoscopic mirror is often of great service in detecting the presence of a small impacted body, and in guiding the surgeon to its position. False teeth not infrequently become dislodged and impacted in the pharynx. Paget has related such a case, where a man in a fit had one of his sets in the pharynx, where they remained four months. They were afterwards dislodged from between the base of the tongue and the epiglottis ('Med. Times,' 1862).

Fig. 249.



Revolving pharyngeal forceps for the removal of foreign bodies, &c.

Examples of impacted false teeth.

In 1864, when performing ovariotomy on a lady, under chloroform, alarming symptoms of suffocation set in, and on opening the mouth I found half a set of teeth had become dislodged and fallen into the pharynx. I have also heard of several similar cases. Before giving chloroform to old people the teeth always should be examined, and false sets removed. When such bodies become impacted, much care is needed in their extraction, and the utmost gentleness used.

Care in extraction.

Wounds of pharynx.

Wounds of the pharynx, as a result of accident, are occasionally met with, falling with a sharp body in the mouth being the most frequent, and when they do not involve any large vessel, they generally do well. Durham relates a case of a boy, æt. 7, in 'Holmes's System of Surgery,' vol. ii, in which Mr. Johnson of St. George's, had to ligature the carotid artery for repeated bleedings following a punctured wound of this part

produced by the end of a parasol, in which an excellent recovery ensued.

Foreign bodies in the œsophagus

Foreign bodies in the œsophagus are mostly arrested at the two narrowest portions of the tube—its origin behind the cricoid cartilage, or at its lower end just above the diaphragm—and anything that can be swallowed may be so impacted. The symptoms to which this accident gives rise are extremely uncertain. When the upper part of the tube is obstructed the laryngeal symptoms are generally alarming (Fig. 250), and when the obstruction is not complete, they may be very slight. Vomiting, however, under both circumstances, will probably take place to expel the obstructing body, and when this is severe, rupture of the œsophagus may ensue. This accident is to be suspected, when, after severe and repeated straining the foreign body is ejected with violence, its ejection being attended with hæmorrhage and followed by emphysema of the neck. An interesting paper on this subject may be referred to, by Dr. Fitz ('American Journal of Med. Science,' January, 1877). As a rule, however, besides the mechanical symptoms, the mere presence of a foreign body in the tube produces, secondary inflammatory symptoms may be set up, which may give rise to a fatal result. Thus, a case is on record, in which a fish bone perforated the heart and caused a fatal hæmorrhage (Andrews, 'Lancet,' 1860); in another, where a sharp spiculum of bone caused ulceration on the third day into the aorta (Spry, 'Path. Trans.,' vol. iv, 1853); and in a third, where disease of the spinal cord ensued as a consequence of ulceration of the intervertebral substance, following the arrest of a piece of bone in the œsophagus (Ogle, J. W., 'Path. Trans.,' vol. iv, 1853). Erichsen also records a case in which a piece of gutta percha formed for itself a bed in the wall of the œsophagus for upwards of six months, and destroyed life by causing ulceration into a vessel and hæmorrhage, and a second, in which a man died suddenly from hæmatemesis, the cause being discovered after death to be a half-crown impacted in the œsophagus, ulcerating into the aorta. Gairdner likewise gives a case where a fish bone passed through the posterior wall of the œsophagus and was found embedded in pus in front of the vertebral column ('Med.-Chir. Soc.,' Edinburgh, 1859), and my friend Dr. Sutton also has told me of an instance where a lunatic so plugged his pharynx with tow as to cause death by suffocation.

Foreign bodies in œsophagus.

Symptoms.

Rupture of œsophagus.

May perforate heart, aorta, &c. &c.

Fig. 250.



Preparation showing a piece of pudding impacted in œsophagus of a child, æt. 2 years, which caused death by laryngeal spasm. Guy's Hosp. Mus., 1793[40].

Diagnosis.

Diagnosis.—It is impossible for a surgeon under all circumstances to say with certainty as to the presence or absence of any foreign body in the œsophagus. When it can be felt by the finger or bougie, no doubt can be entertained; yet, on the other hand, when no such evidence is obtainable it may often be present, for a foreign body of small size may become so fixed in one side of the tube as

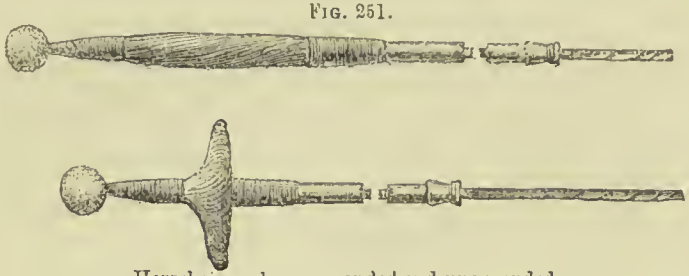
to escape detection in the passage of an instrument. The best bougie for diagnostic purposes is one made of whalebone, with a smooth polished iron knob at its end, the one with a sponge at the end being useless.

Treatment.

If soft or digestible may be pushed down.

TREATMENT.—When a foreign body is detected, the sooner it can be taken away the better. If the material be *soft* and *digestible*, it may be pushed downwards by means of an ordinary sponge or ivory probang or the tube of a stomach pump, care being taken not to use force, for such material will soften by the natural secretion of the part after the lapse of a few hours, and thus will be more readily pressed on. Should, however, the offending body be pointed, hard, or large, all idea of pushing it on must be dismissed, such a practice being most dangerous, although it has been done with impunity; a jagged plate with teeth having been pushed into the stomach and passed per anum.

FIG. 251.



Horsehair probang expanded and unexpanded.

Horsehair probang.

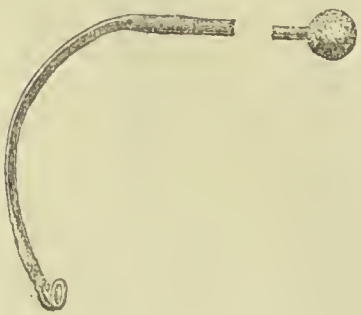
Small pointed bodies may be caught by the "horsehair" probang (Fig. 251), passed carefully beyond the position in which the foreign body is supposed to be placed, and then gently expanded, rotated, and withdrawn, the compression and rotation of the instrument causing the hair to spread out and to expand the œsophagus. *Sharp-pointed bodies* or *impacted hard irregular bodies* should, when possible, be removed by forceps. Those figured in No. 249 are the best, as they can be made to open when in the pharynx in all directions.

Forceps.

Emetics.

Vomiting will often cause the dislodgment of a foreign body, though at times it may render it more fixed. When vomiting cannot be produced by the administration of medicine, a solution of tartarized antimony, or of apomorphia gr. $\frac{1}{10}$, injected beneath the skin is said to act as well.

FIG. 252.



Money probang, with sponge at one end.

Coins and other flat but not pointed bodies can often be removed by means of the money probang (Fig. 252), the circular hook catching the coin and drawing it upwards.

Swallowing a large bolus of bread may carry downwards any fine bone or bristle, a draught of any liquid assisting the process.

Œsophagotomy for removal of foreign bodies.

Œsophagotomy has an established position in practical surgery, and the principles laid down many years ago by Arnott, are now generally accepted, viz. "where a solid substance, though only of moderate size and irregular shape, has become fixed at the commencement of the

œsophagus, or low down in the pharynx, and has resisted a fair trial for its extraction or displacement, its removal should *at once* be effected by incision, although no urgent symptoms may be present" ('Med.-Chir. Trans.,' vol. xviii). Mr. Cock endorsed this opinion when he wrote in 1867 ('Guy's Rep.'): "The longer a foreign body is allowed to remain, unless we wait—a forlorn hope—for suppuration to loosen it, the more firmly it will become impacted. It would appear that success attends a speedy operation; whereas, where the use of the knife has been delayed until local inflammation, suppuration, or even sloughing has been established, the result of the operation has been fatal." Up to the end of 1877, 28 cases of this operation for the removal of foreign bodies have been recorded, and of these 23 were successful, the three last added to those given by Dr. David Cheever, of Boston, 1868, including two of Dr. Le Roy McLean, of Troy ('New York Med. Record,' 1877), and one of Mr. Wheeler's, of Dublin, 1875, and two of Langenbeck's ('Med. Record,' March, 1878).

For stricture and cancer of œsophagus.

More recently the œsophagus has been opened for stricture and cancer of the passage, and Dr. Menzel reports ('Wiener Med. Wochenschrift,' No. 56, 1870) two cases in which Billroth performed it. That which was successful occurred in a boy æt. 11, who seven years before had swallowed some potash lye. For two days before the operation neither liquid nor solid food could be swallowed, nor bougies passed. The œsophagus was opened and a cherry stone which had been fixed in the stricture removed. The boy drank water directly afterwards, and, in twenty-six days the wound had healed. The report does not say that he could swallow freely. The second case was for cancerous disease, but the man died.

Œsophagotomy for stricture and foreign body.

The operation.—The patient should be placed in the recumbent position with his shoulders slightly elevated, the head being turned to the right or left side according to the point of projection of the foreign body. Where this guide is lost the left side should be selected, the œsophagus inclining rather to that side. An incision should then be made along the anterior border of the sterno-mastoid muscle, about four or five inches long, its centre corresponding to the position of the foreign body, and all the soft parts carefully divided. The omo-hyoid will then come into view, and underneath this, the carotid sheath with its vessels will be seen. The deep cervical fascia is then to be laid open, and if more room be required the sterno-hyoid and sterno-thyroid muscles may also be partially divided. The vessels with the sterno-mastoid muscle, should then be drawn well outwards by means of hooked retractors. The larynx with the œsophagus behind can then be examined, and the position of the foreign body accurately made out, pressure with the finger on the opposite side tending materially to make this point clear. Should the foreign body project, the larynx may be drawn well forward or towards the opposite side, and a cut made down upon the projecting part, the wound being carefully enlarged to allow of an extraction without force. When the foreign body does not project, a guide should be used, such as a silver catheter, flexible lead or tin sound, or a long pair of forceps introduced through the mouth downwards into the pharynx, the point of the instrument pressing forward the œsophageal wall. All vessels that bleed during the operation should be at once twisted or ligatured. On opening the œsophagus, the recurrent laryngeal nerve should be carefully avoided. The wound should be left open. The patient must be fed for a few days by means of a small œsophageal tube, introduced through the mouth

Operation of œsophagotomy.

Mode of performance

into the œsophagus below the wound, care being taken during its introduction to keep the point against the opposite wall. Convalescence, as a rule, goes on steadily. I have been fortunate enough to see the operation successfully performed twice by my colleague, Mr. Cock, and the facility with which it was done has given me a very favorable opinion of its value. ('Guy's Rep.,' 1858, 1867.)

CHAPTER XIV.

INJURIES OF THE ABDOMEN.

Contusions and Rupture of the Viscera.

Injuries of the abdomen like those of the cranium, derive their principal importance from the nature of the cavity's contents. The integuments and muscles forming its parietes may be severely injured and results follow which are simply of local importance; but when the peritoneal lining of the cavity is involved, or any of the viscera are injured, the case assumes a grave aspect. The presence of a wound is always an extra element of danger, and is to be measured by the extent and character of the visceral complication.

On the other hand the gravest internal abdominal injuries may coexist with the slightest external evidence of mischief.

Contusion.

Under certain conditions, a trifling blow on the abdomen may give rise to symptoms of an alarming nature, though a severe one is recovered from without exciting more than a fear. "The absence of shock immediately succeeding a severe lesion may lull suspicion, as its presence may by simple contusion excite alarm." Every abdominal injury, however trivial it may appear, must consequently be regarded with apprehension, and the utmost care observed in its treatment. This can be easily accounted for, Poland says ('Guy's Rep.,' 1858), "when we consider the numerous and vital structures contained in the abdomen: a serous membrane highly prone to inflammation; the 'peritoneum,' occupying an extensive amount of surface; a lengthy coil of organised tubing, 'the stomach and intestines;' solid substances, made up chiefly of blood-vessels, &c.; the liver, spleen, and kidneys readily lacerable and liable to rupture, causing nearlys always fatal hæmorrhage; receptacles for fluid, 'the gall and urine bladders,' which, under distension and undue force, may burst; large vessels coursiug along the posterior wall, 'the aorta, vena cava,' &c.; and lastly, above all, the sympathetic nerves, consisting of the solar plexus and its numerous satellite plexuses and branches of such high organic importance, that injury or shock thereto may be attended with irreparable results. All these structures are, moreover, enclosed with soft elastic parietes, capable of great distension, which although readily able to resist shock and external violence without injury to themselves, yet may allow the force to be transmitted and expended on the contents with dire effect, and yet without leaving a trace or mark iu the exterior."

General remarks on the abdomen.

Diagnosis of the effects of contusion difficult.

In forming a diagnosis in this class of cases exclusion is the only sound method, every possible complication should be entertained and dismissed only when the weight of evidence is against it, the ultimate conclusion being founded as much on negative as on positive evideuce.

"I am unacquainted," writes Le Gros Clark ('Surgical Diagnosis,'

1869), "with any diagnostic sign by which we may predicate whether shock following an abdominal injury exists primarily, apart from, or as expressive of actual breach of texture. Time alone can develop the true nature of the case, either br renewal of vigour or by the development of fresh symptoms." A severe internal injury may likewise exist without shock. Only developed in the progress of the case.

An injury to the abdomen from a blow, fall, or the passage of a wheel over the part may cause either a contusion of the abdominal wall more or less severe, with no visceral complication whatsoever; or a laceration or rupture of a viscus or vessel which will end in death without any (or very slight) external sign of mischief. Symptoms as a guide.

Pain as an immediate effect of injury is no indication of internal mischief, for in simple abdominal contusions it is at times very severe. When, however, it *lasts* or becomes *fixed*, it is a symptom of importance; and, when it *radiates* from a point, it is most characteristic. Pain.

Persistent vomiting is always a suspicious symptom of visceral injury. Persistent vomiting.

Collapse, as a direct consequence of a blow, is of small value as a diagnostic sign, when of a passing nature; although when *persistent* or *relapsing* it indicates great mischief; as more or less complete collapse is a common effect of all abdominal injuries. A collapse, however, coming on at a distinct interval of time after an injury, as a rule means internal hæmorhage. Collapse. Relapsing collapse.

How far sudden death is attributable to a shock or collapse from a blow on the epigastrium or stomach without organic lesion is an open question, sound evidence being wanting to prove the fact. Dr. A. Taylor, in his 'Medica Jurisprudence,' adduces a case, that of Mr. Wood, in which a man, when fighting and intoxicated, suddenly died after the receipt of a left-handed blow on the pit of the stomach; but the evidence in the case as well as the facts revealed at the post-mortem were by no means conclusive as to the cause of death. The opinion has probably been accepted on the authority of Sir A. Cooper, who was in the habit of relting that as two men were working, one of whom was wheeling along a heavy load, his comrade thus addressed him: "That is too much for you; stand aside, and let me, a better man, take it." He accompanied these remarks with a slight blow on the scrobiculus cordi and the man immediately let the barrow fall and died on the spot. After death no lesion was discovered. The case, however, had only been related to Sir A. Cooper, nor can a better be brought forward to support the theory. Under these circumstances, I concur with Mr. Pollock when he asserts, that he is somewhat sceptical on the point that death can occur without any organic mischief resulting from the blow at the time; that "sudden death attributable to a blow on the stomach or epigastrium must be a rare occurrence; and that medical men should be extremely guarded in ever offering an opinions as to the cause of death in such supposed injuries, without satisfying themselves, by most careful and minute post-mortem investigation, that no violence has been done to the viscera, either abdominal or thoracic." ('Holmes's Surgery,' vol. ii.) This question may, therefore, be summarily dismissed. Sudden death from shock. Sir A. Cooper's case. Pollock's remarks.

What then, it may be asked, are the usual consequences of an abdominal injury or contusion? and what are its risks and complications? The following facts will answer these queries.

Effects of contusion in 71 cases.

Passing collapse in 44.

Peritonitis in 10.

Ruptured viscus in 17.

At Guy's Hospital, during eight consecutive years, seventy-one cases of abdominal injuries were admitted. In *forty-four*, beyond a passing collapse, no serious or definite symptoms followed; tenderness over the injured part from the contusion was the most marked, but no evidence of any internal mischief showed itself. In these cases, rest in bed for a few days, with the local application of a warm fomentation, was the chief treatment, and in all, convalescence was rapidly established. In *ten cases* symptoms of *peritonitis* followed, as evidenced by excessive tenderness over the injured part, increased by movement, thoracic respiration—resulting from the indisposition of the abdominal muscles to act, and thus by pressure on the inflamed peritoneum to cause pain—nausea, and in some cases vomiting. Fever, and constitutional disturbance, varied according to the severity of the inflammation. In seven of these ten cases, *absolute rest* in the horizontal posture, local warm applications, either by means of fomentation or cataplasms, in some instances leeching, and *in all, opium* given in moderately full and repeated doses was the treatment adopted; and in every case, the inflammation was subdued before it had attained a dangerous degree of severity. In the remaining *three cases*, however, acute peritonitis set in, and in one terminated fatally. In *seventeen* cases, or about one fourth of the whole number, rupture of the viscera took place. As a type of an ordinary case of peritonitis after injury, I adduce the following case:—

Typical example of peritonitis after blow.

A man, æt. 22, received from a woman, while fighting, a blow on his right side, which was followed by syncope, but from which he soon recovered; no pain or inconvenience followed the injury for a week, and the man resumed his usual occupation. At this date severe abdominal pain appeared at the seat of injury, which rapidly increased and spread over the whole abdomen; vomiting also began, accompanied with considerable constitutional disturbance; and in this condition he was admitted into Guy's. He was put to bed, twenty leeches were at once applied and a grain of opium given, which was ordered to be repeated three or four times daily; perfect rest was also enjoined. In a few days these symptoms subsided, and he was enabled to take food without vomiting, pain ceased, and convalescence became gradually established.

Remarks on the case and treatment adopted.

Importance of rest.

REMARKS.—Such a case is interesting from the fact that some days elapsed between the receipt of the injury and the appearance of the peritoneal symptoms, as well as from the important practical point to be learnt from the rapid success that followed upon the treatment which was pursued. Rest, to its fullest extent, was doubtless the chief element of success—rest by position in the horizontal posture, and rest maintained by the administration of opium. It is not unfair to maintain that if this treatment had been adopted earlier, the symptoms exhibited would never have made their appearance; but the man following his occupation, the repair which was required after the injury could not be efficiently carried out, and as a consequence, inflammation ensued. Of all cases abdominal injury require absolute rest, and in no example, however apparently trivial, should it be neglected. If the mischief is but little, that little will more rapidly be repaired; if great, its evils and its consequence will be materially modified. The case already quoted indicates both points, viz. its primary necessity and its secondary good results.

It is thus seen that a blow upon the abdomen may be followed by a

simple contusion of the abdominal wall, and, in exceptional cases, by peritonitis which may terminate fatally, although in the majority where such a result ensues, it is from rupture or lesion of some internal part. A local peritonitis, after an injury, is not, however, to be looked upon with displeasure, for, as pointed out by Mr. Hilton, the coagulable lymph which is poured out under these circumstances forms a temporary splint until the injured structures repair themselves. The inflammatory effusion producing a certain degree of rest to the injured structures, and thus contributing to the work of reparation.

Signs of ruptured viscus obscure.

What then are the symptoms of an internal abdominal lesion? How can the presence of such be made out? And what guides are there to the viscus that is wounded?

To answer these questions satisfactorily much space is needed, more, indeed, than can be well spared in this work; yet helps to diagnosis may be given, and among these, the nature and position of the injury are the best. Where the loins are the part involved, the kidneys are most likely to suffer; where the right hypochondriac region, and the ribs on that side are fractured, the liver is probably the organ that may be injured. On the left side, the stomach, or, more probably, the spleen; in the umbilical region, the intestines; in the pelvic region, the bladder.

Proximate guides.

Ruptured liver.

Rupture of the liver usually destroys life by hæmorrhage, and in the majority of cases within a few hours of the injury, in some, within a few days. Thus out of nine consecutive cases of ruptured liver, five died rapidly, three survived, three, seven, and nine days respectively.

Recovery may ensue after ruptured liver.

There is little doubt, however, that recovery may take place when the fissure is limited and the case uncomplicated; when these occur they are classed with those of traumatic peritonitis; when they prove successful their true nature is not revealed. Preps. 1948—1951[5] in Guy's Hosp. Museum, with drawings, illustrate this truth.

Extensive.

When the laceration is *extensive*, death is always speedily produced by the shock and hæmorrhage; coldness and general pallor of the whole body, with a feeble pulse, sighing respiration, and restlessness preceding the fatal issue.

Slight.

When the laceration is *less severe* life may be prolonged; and I have recorded in another work the case of a man æt. 45, who, when drunk, fell from a cart, and the wheel was said to have passed over his head. Intoxicated to an extreme degree, he was admitted, under Mr. Birkett's care, into Guy's Hospital, presenting no evident symptoms of internal injury indicative of cranial mischief, beyond slight hæmorrhage beneath the right conjunctiva. He was put to bed, soon fell asleep, and, on the following morning, with the exception of the hæmorrhage into the orbit, *no signs* of mischief could be detected. Rest, however, in the horizontal position, was strictly enjoined; but to this he would not submit, and, thirty-six hours after the accident he got up, walked about, and with a sudden pain in his side, fell back, and died. After death, a fissured fracture passing across the right orbit was found without brain complication and about a pint of blood, in the peritoneal cavity which had evidently escaped from a severe laceration of the liver; a mass situated in the right lobe the size of a man's fist having been nearly separated. The right kidney was also fissured on its surface, and covered with coagulated blood. In this case the man clearly died from secondary hæmorrhage the result of the ruptured liver.

In rare instances the liver may be crushed partially, and, strange to

say, its peritoneal covering be uninjured, yet in such cases life can be prolonged, and, when the mischief is not extensive, may be saved.

Fissures of the liver are usually met with on its upper surface, and a diseased organ is more liable to rupture than a healthy one.

Ruptured spleen.

The spleen is frequently injured, and such cases are by no means always fatal. Prep. 2018, Guy's Museum, illustrates its repair after injury. This organ, too, is sometimes lacerated by a fractured rib, or torn by a dragging of its surface. When fatal, the result occurs from hæmorrhage.

Subdiaphragmatic abscess.

Subdiaphragmatic abscess may occur as a consequence of abdominal injury, and the surgeon should suspect its presence in all cases where recovery is slow and attended with abdominal pain.

Ruptured stomach.

Rupture of the stomach generally proves fatal from shock alone, or irrecoverable collapse; the amount of distension of the organ, its contents, and the extent of laceration, influencing the result. When the rupture is large and effusion of its contents into the abdominal cavity takes place, acute peritonitis, with or without hæmorrhage, will prove fatal, if the shock does not. When the rupture is small, and the stomach empty, there is some chance of recovery, local peritonitis subsequently gluing the injured part to the surrounding tissues.

Symptoms and result.

When death is not immediate, the patient will complain of an acute and constant pain radiating from the seat of injury, so peculiar indeed that "the intensity of it absorbs the whole mind of the patient, who, within an hour from the enjoyment of perfect health, expresses his serious and decided conviction that if the pain be not speedily alleviated he must die." Vomiting is a constant symptom, first of the contents of the stomach, and often afterwards of blood; collapse, rigors, and syncope are often met with.

Incomplete rupture of coats.

Incomplete rupture of the coats of the stomach is found sometimes after death, and, in Guy's Museum (Prep. 1817[25]) there is the stomach of a child æt. 7, in which, from a sudden blow upon the distended viscus, the mucous membrane was detached and lacerated in a remarkable manner.

Ruptured intestine.

Rupture of the intestines, both large and small, is a somewhat common form of abdominal injury, and may be produced by a fall, a blow, the passage of a wheel over the abdomen, or even violent muscular exertion. Hennen ('Military Surgery') gives a case where a soldier received a

Examples.

contusion of the abdomen, and sloughing of the integument followed with artificial anus, yet in six months the fæces resumed their natural course and a recovery took place. In Guy's museum there is a specimen (Prep. 1851[85]) of perforation of the small intestines of a man who had received a kick from a horse and died thirteen days after the accident with extensive peritonitis, from fæcal effusion. Prep. 1851[86] consists of a portion of jejunum, taken from a man who had been kicked in the abdomen, the injury being quickly followed by symptoms of extravasation and death in forty-eight hours; Prep. 1850[88] was taken from a case of perforation of small intestine from the kick of a horse, terminating in death in twenty-four hours; No. 1851[89] is a portion of jejunum in which are two openings through which the mucous membrane is inverted and resulting from a kick in the abdomen; No. 1851[91] is an example of laceration of the jejunum in which the bowel is completely divided. It was taken from a man æt. 37, who had been run over by a cart, and lived twenty-four hours. Lastly, the specimen marked 1851[87] is from a case that occurred in the practice of my father,

the late Mr. T. E. Bryant of Kennington, and is a portion of ileum in the coats of which there is a small perforation, the injury being produced by running against a post, and followed by collapse, from which the patient did not rally, but died on the third day.

Recovery after sloughing of intestine.

Cases are also on record in which, after an injury, a portion of intestine has sloughed and subsequently passed per rectum, a recovery taking place. In the Anatomical Museum of the University of Edinburgh several such preparations exist.

Ruptured duodenum.

The duodenum is rarely ruptured, its position protecting it; nevertheless such an accident does occur. Taylor, in his 'Medical Jurisprudence,' gives a case, where a boy æt. 13, after a blow on the abdomen, walked a mile with but little assistance, and, when he died (thirteen hours after the accident), the duodenum was found to be completely ruptured across.

Ruptured jejunum.

The jejunum is doubtless more frequently ruptured than any other part of the intestines, its fixed position rendering it liable to be torn away from the duodenum by such an injury as the passage of a wheel over the abdomen. Poland gives fourteen examples of this kind, and in half of these the laceration was at its upper part. In one case, after death, three or four pints of thin pink-coloured fluid was found in the abdomen, probably the iced water of which he had freely partaken after the accident, and in all, death took place from collapse and peritonitis.

Ruptured ileum.

The ileum is also frequently ruptured, and most commonly from a direct blow or fall on a hard body. In the majority of such cases there is no external mark of injury, and fæcal effusion with peritonitis are the usual causes of death. When the rupture is large, little hope exists of a recovery; when small, such a hope, however, may be entertained.

Blow on hernial tumour.

When a patient is the *subject of hernia* and receives a blow upon the tumour, a ruptured intestine may doubtless take place. Aston Key made this the subject of a memoir in the 'Guy's Reps.' for 1842, and Poland has collected many such cases in the same periodical for 1858. Rupture of the gut is the usual result of such an accident, and when it occurs, a fatal termination is to be expected. When the bowel is only bruised, however, it may recover or slough, and be followed by an artificial anus.

In none of these cases should any attempt at reduction be made, when symptoms of inflammation or of injury are severe. The surgeon should, however, explore the sac. In all recorded cases where the bowel was returned, a fatal result took place.

Ruptured large intestine.

The large intestine is rarely ruptured from violence. When over-distended from fæcal accumulation the result of stricture or otherwise, such a result may ensue; but, under ordinary circumstances it is too well protected. I have, however, known florid blood to flow from the bowel after an abdominal contusion, and have, from that fact, suspected some laceration of the colon.

Treatment of ruptured intestine.

Treatment.—The chief point to insist on is the absolute necessity of treating *every case* of injury to the abdomen with excessive caution, as very severe mischief may be caused by violence and yet the immediate symptoms not be marked. Collapse after the injury, as has been shown, is by no means a necessary consequence; for rupture of the intestine itself may take place without exciting such a condition; indeed, a patient may walk after a ruptured liver or intestine. The surgeon, therefore, should be guarded in his prognosis as well as careful, watchful, and expectant in treatment.

Rest.

In every case absolute rest should be secured and maintained. If the injury be slight, convalescence will soon be established by such treatment; if severe, secondary bad results may be prevented, and, at any rate, be relieved. No case of abdominal injury can be pronounced well within a fortnight.

If local tenderness exists, fomentations or cataplasms should be used; and if it amounts to pain, leeches in large numbers (twenty or thirty) must be applied. In some cases, however, the application of ice gives more relief. Opium should always be given in small and repeated doses, as it allays pain, assists wonderfully in maintaining rest to the injured peritoneum and viscera, and tends materially to arrest inflammatory action.

Opium.

The patient should be kept free from all excitement, and as little nourishment administered by the mouth as will suffice to sustain life; if the intestines are believed to have been ruptured, *starvation* treatment must be carried out. Whatever is given should be liquid and cold. Milk and ice is the best and simplest combination, and upon this life can be sustained without difficulty. If great thirst exists, ice may be given; but this must be administered with caution, as the case already quoted well illustrates. When the intestine is believed to be injured, the allowance of fluid must be very scanty, the patient's powers being kept alive by enemata of beef tea administered in small quantities, say three or four ounces repeated at short intervals.

Starvation.

Ice.

Nutrient enemata.

Never administer purgatives.

On no account ought a purgative to be administered. This rule is golden in these cases, and should never be deviated from; as by infringing it in a careless moment, the whole of nature's processes in repairing the injury may be undone, and irreparable mischief follow. Constipation is the sign of a passive condition of bowel to the preservation of which all our treatment is directed, a purgative being merely an irritant, and in its effects absolutely destructive.

Cautious prognosis.

Always examine the bladder.

In all cases the prognosis and treatment should be most guarded, cautious and expectant; and, in all, the *state of the bladder* should be well attended to, for retention of urine from disturbed nerve influence is a common accompaniment and must not to be overlooked.

Ruptured kidney.

Rupture of the kidney is an accident from which recovery is more common than from any other viscus. Its position in the loins outside the peritoneal cavity, being doubtless a sufficient explanation of this fact; indeed, when not very severe and uncomplicated with other injuries, such cases usually do well. It is generally known by an attack of hæmaturia and local pain following a blow on the lumbar region. The hæmaturia may be but slight and passing, or not show itself till the second day. It may cease also after the lapse of two or three days, when it is probable that only a contusion of the kidney had taken place, for in more severe injuries the bleeding may last fifteen days or even more. At times clots will be passed, assuming the shape of the ureter, and I have before me the notes of some half dozen cases in which these symptoms were present, and from which recovery took place. These clots, however, at times give rise to retention of urine by blocking up the urethra. Retraction of the testicle is an occasional symptom, and so is pain in the course of the ureter.

Symptoms.

Treatment.

The treatment to be pursued in these cases is, rest in bed and milk diet. In some cases where the bleeding is profuse, a grain of the acetate of lead may be given with half a grain of opium three times a day, or

gallic acid in ten-grain doses. The tincture of ergot in full doses is also a valuable drug under similar circumstances. Opium, however, should be given with caution.

When the organ is crushed, the injury is likely to be complicated with other mischief, and, under such circumstances, peritonitis and hæmorrhage, singly or combined, generally prove fatal. When the organ is single and becomes injured, a fatal result is also likely to occur. In page 125 of my 'Clinical Surgery' I have recorded such a case.

When peritonitis exists, opium is of great value; where urinary abscess in the loins follows, as it occasionally does, particularly in gunshot wounds, the surgeon must make a free incision into it on the outer border of the quadratus lumborum muscle.

Ruptured ureter.

Rupture of the ureter was first noticed by Stanley in the 'Med.-Chir. Trans.,' vol. xxvii, and in the two cases he related, a fluctuating tumour formed by the effusion of urine existed in both. Poland, in the 'Guy's Rep.' for 1868, has recorded a third case; but beyond these no others are on record. Four cases of wounded ureter are, however, published by Hennen ('Mil. Surg.'). In all these cases it seems the ureter was ruptured by stretching, its renal end having suffered; and I have seen two of these which occurred in the practice of my colleague Mr. Howse.

Symptoms obscure.

The symptoms are very obscure, particularly where no external wound exists; indeed, there are none to indicate the nature of the accident in its early stage. At a later period a lumbar tumour may appear of a cystic nature caused by the retention of the secreted urine, and there may be more or less peritonitis. When a lumbar swelling exists, tapping the cavity should be performed, the operation being repeated from time to time as the fluid re-collects, the kidney in time probably ceasing to secrete. When this treatment fails, there is little doubt that a free opening into it in the loin is the correct treatment. Under other circumstances, the case must be treated as all others of abdominal injury, by rest and opium.

Wounded ureter.

Mr. Holmes records in the 'Med.-Chir. Trans.' for 1877, vol. xlii, an interesting case of wound of the ureter which occurred in a boy æt. 13, where a clasp knife had entered his body from behind, upwards and outwards just on the right of the middle line, and about on the level of the posterior superior spine of the ilium. The wound discharged urine for two weeks and then closed, the boy recovering.

Ruptured gall-bladder.

Rupture of the gall-bladder has been recorded as the result of accident, and when it occurs, death is usually rapid. The accident is marked by extreme collapse and pain in the seat of injury. Poland, in his 'Fothergillian Prize Essay,' has given us such a case, and Dr. Fergus, in the 'Med.-Chir. Trans.,' vol. xxxi, has recorded another. In one the death occurred from collapse, and in the other from peritonitis.

Ruptured hepatic duct.

Rupture of the hepatic duct may also occur. In Poland's Fothergillian Essay such an instance is recorded, and occurred in a boy as the result of a blow on the abdomen, the accident being quickly fatal. My friend Dr. Sutton has kindly given me the details of a second case, which took place in the London Hospital in 1867. It was in that of a man, æt. 29, who was knocked down, and the wheel of a spring dray passed over his stomach. He felt pain in the right hypochondriac region directly, and "had hard work to get his breath." Abdominal pain increased and jaundice appeared, and for a month he kept his bed.

On the thirtieth day after the accident, as he did not improve, he was admitted into the London Hospital, under Drs. Herbert Davies and Sutton. Then he had abdominal pain, tenderness, and distension. There was distinct ascitic fluctuation over the abdomen, and deep jaundice. He sank eight days after his admission, and thirty-eight days after the accident. The autopsy revealed the fact that the hepatic duct was torn across a quarter of an inch above the spot where the cystic joins the common duct; no other part of the liver was injured. The abdominal cavity contained quarts of olive-green bile-stained fluid, and the peritoneum was covered with yellow matter of the colour and consistence of paint, which was found to be inspissated bile.

Ruptured urinary bladder.

Rupture of the urinary bladder without fracture of the pelvis is also to be met with as the result of some abdominal injury, and, when it occurs, is usually due to external violence applied to a distended organ.

Seat of rupture.

As a rule the rupture takes place at its posterior wall, the urine escaping into the peritoneal cavity, and rapidly causing death. In exceptional cases it affects the anterior wall, when the urine infiltrates the cellular tissue of the pelvis.

Results.

Birkett tells us ('Holmes's Surgery,' vol. ii) that, with three exceptions, all the cases recorded, terminated fatally. In one only of these three was the peritoneum involved (Chaldecott's case, 'Prov. Med. Surg. Journ.,' 1846), in the other two the extravasation was into the pelvic connective tissue. Dr. Stephen Smith, of New York, in an able monograph, 1851, reports five cases of recovery out of seventy-eight, these figures not including one of Birkett's (Porter's case), consequently the recoveries reported amount to six.

Symptoms.

The symptoms of the injury are mostly collapse, preceded by severe abdominal pain and ineffectual attempts to micturate. When life be prolonged peritonitis more or less acute will appear. Dr. Smith reports three cases in which the inability to urinate continued, and twelve in which it returned on the second or a later day.

Rupture of the bladder with fracture of the pelvis likewise occurs.

If the surgeon be induced to pass a catheter from the ineffectual efforts of the patient to pass urine, it will often happen, that no success will be achieved, but in some cases, a vast amount of fluid will be withdrawn, the catheter under these circumstances having doubtless been passed through the rent in the posterior wall of the organ into the peritoneal cavity. I have known a case where several pints of fluid were drawn off under these circumstances.

Treatment.

TREATMENT.—When any time exists for treatment, the indications are, to *allow of a free exit for the urine as soon as secreted*, and, to check peritonitis. A certain amount of peritonitis must be looked upon as beneficial, as it tends towards the first indication of treatment, the prevention of extravasation, but any excess of action requires prompt

Opium.

treatment. Opium is without doubt the best drug to promote this end, a full dose of the solid or the tincture being given, and followed up to maintain its action; absolute rest, local fomentations, and possibly leeches are valuable adjuncts. As little food should be given as is absolutely necessary to maintain life, and ice in moderation to allay

Use of catheter.

thirst. The bladder should be kept empty, the maintenance of a large catheter in the viscus, with an opening in the end, being the best method, according to Birkett; though it seems probable that a free inci-

sion through the perinæum into the organ, as in lithotomy, is the better practice, as it is when the bladder is ruptured from a fracture of the pelvis.

Injury to the uterus, when large from pregnancy, deserves a passing notice, for such cases are serious. A contused organ may inflame, and be followed by absorption or miscarriage, or should pregnancy continue, its structure may be so altered as to be liable to rupture. I have known also an intra-uterine fracture of a child's thigh to take place as a consequence of a fall. In obstetric works cases are recorded in which a distinct rupture of the organ followed. Injury to uterus.

Rupture of an ovarian cyst from a blow is also recorded, and, under certain circumstances a good result may take place; all obstetricians have met with such cases. As a rule, however, a fatal peritonitis follows. Ruptured ovarian cyst.

Rupture of the diaphragm is an accident that occurs in practice, but difficult to diagnose. It is generally the consequence of some violent injury, such as a crush, or the passage of a heavy wheel over the waist. In such cases the injury is complicated, and usually with hernia of the abdominal contents into the thorax. This injury can only occur on the left side. Dr. Wilks, in the 'Lancet' for 1858, reported three instances of this diaphragmatic hernia, and pointed out that *excessive thirst* was the most prominent symptom in each. I had the opportunity of seeing these three cases, and others since have come under notice, and this symptom of thirst seemed to be most characteristic; thirst insatiable. In January, 1872, a case of this kind came under my care with this symptom well marked. Ruptured diaphragm.

Wounds of the Abdomen, involving Parietes and Viscera.

The parietes of the abdomen are often wounded by sharp substances, whether by accident or design, and so long as the wounds are confined to the parietes the danger is small. When the peritoneum is punctured or perforated, the viscera are also probably involved, and, under such circumstances, the case becomes serious. In rarer instances the intestines protrude, when an additional element of danger is added.

Wounds of the parietes alone require the same treatment as wounds of any other part. The surface should be well cleansed, and all foreign bodies removed. Hæmorrhage should be arrested by torsion or ligature, and the edges of the wound brought together with sutures. In deep or lacerated wounds, where the risk of suppuration between the muscles or fascia is great, absolute rest in the horizontal position should be enjoined, the muscles being thus relaxed. When suppuration appears, the surgeon must be careful to let out all fluid either by reopening the wound, or, by a fresh opening. In all wounds of the parietes, the surgeon should be particularly careful to arrest bleeding at once, and to let out anything like pus as early as possible. *All punctured wounds should be left open;* when bleeding persists, the wound should be enlarged and the vessel secured. Wounds of the parietes.

Penetrating wounds of the parietes.

There is always a difficulty in diagnosing these cases; that is, in making out the true nature of the accident, more particularly in punctured wounds. When the depth of the wound is known by the extent of insertion of the offending body and the relative position of the viscera at the wounded spot also, some notion as to its nature may Penetrating wounds. Diagnosis difficult as to extent.

be formed; but when no such guide can be found, the surgeon has to rest upon other evidence, such as surmise and probabilities. As a rule, where want of evidence is felt, it is well to treat the case as serious. All penetrating wounds are serious, whether incised, lacerated, punctured, or gunshot, but punctured wounds are by far the most common.

When the viscera are *uninjured*, there will be a total absence of all other symptoms beyond the parietal wound, *and these negative symptoms afford the best positive evidence of the simple nature of the accident.*

Symptoms when viscera injured.

When the viscera are *injured*, there will generally be more or less lasting syncope, or collapse; there will probably be severe local pain, soon becoming radiating; there will also frequently be vomiting, possibly of blood, or the passing of blood from the bowel or bladder. If life is prolonged there will be peritonitis. When the bowel or omentum protrudes, when the fæces, bile, urine or blood appear at the wound, the evidence is clear. The surgeon, however, will find much help from collateral evidence in forming an opinion; as, the size of the wound compared with the instrument that inflicted it; the position of the blood stain on the instrument; the force with which the blow was struck; the direction of the force in relation to the position of the patient; and the thickness of the abdominal parietes. By all these means an approximate opinion may be formed, but in no case can a positive diagnosis be made with certainty. Under all circumstances, however, the *treatment* must be the same.

Collateral evidence important.

Treatment.

Rest.

Opium.

Low diet.

Rest.—Absolute rest being an essential point, no movement should be allowed, not even for passing the evacuations. *Opium* in moderate or full doses, according to circumstances, is also demanded, it being well to keep a patient under its influence for several days, by giving one grain every four or six hours. *Low* diet, that is, milk diet, should be allowed, all food being given cold and in small quantities; ice to suck is refreshing. *Purgatives* should on no account be given till the nature of the case is declared. With respect to *local treatment*, the greatest simplicity should be employed. The wound should be cleansed, and all bleeding vessels secured, but anything like an exploration of the wound is to be condemned. All probing, fingering, or manipulating the wound should be avoided as dangerous and only pertaining to surgical curiosity.

Local treatment.

Sutures.

The abdominal muscles should always be relaxed by position, and the edges of the wound, when it is large, brought together by sutures. Water dressings should then be applied. Punctured wounds when perforating, like others, should be left open. Even after the lapse of some days, when no symptoms of wounded viscera appear, the same caution should be observed, two or three weeks being always allowed before freedom is given. Under all circumstances the condition of the *bladder* should be inquired into.

Penetrating Wounds, with protruding Viscera.

General remarks.

It is hardly necessary to remark that the special risk of any of these cases is determined greatly by the viscus that is involved, and the amount of injury it has sustained. Thus, a penetrating abdominal wound with protruding omentum is far less dangerous than when hernia of the intestine exists, and a protruding wounded bowel is of graver importance than an uninjured one. It is consequently necessary for

the surgeon in all these cases mentally to run over the position of the viscera, in order that he may form an opinion as to the probabilities of the case. Fig. 253 will refresh his memory on these points.

"Of the hollow viscera any portion of the intestinal canal may be protruded, from the stomach to the sigmoid flexure, according to the

Fig. 253.

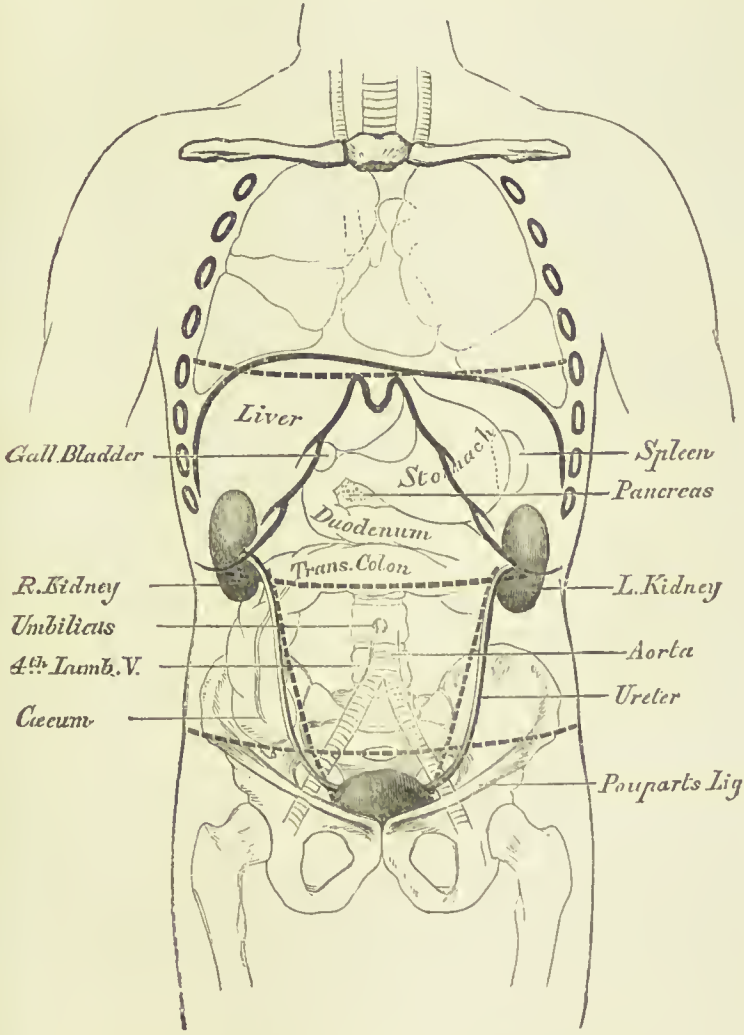


Diagram showing the positions of the abdominal viscera.

situation and degree of distension of the viscera. The small intestines most frequently, next the large, then the stomach, and, lastly, the cæcum. Of the solid viscera the omentum is by far the most common, and is often associated with that of the viscera." (Poland's 'Prize Essay.')

In *small* wounds a limited hernia of the abdominal contents can

alone take place, but when it occurs, the protruded viscus is very liable to be strangulated. In *large* wounds, the hernia will probably be of greater extent, but their constriction is rare.

Protruded omentum.

When omentum protrudes through a recent wound and is uninjured, it should be washed by means of a stream of water squeezed over it from a sponge or emitted from a syringe, and returned with all gentleness, the patient being placed in such a position as to relax the injured muscles. The wound should never be enlarged to allow of the return of omentum When the omentum has been extruding for some time, and is congested from incarceration or strangulation, when it has become inflamed or perhaps sloughing, it is well to leave the mass alone, at least, it is not wise to make any attempt at its reduction. As time goes on and the projecting mass swells and granulates, it may be well to ligature the whole in halves. This should not, be done, however, for at least two weeks after its protrusion. During this time the greatest quiet should be enforced, and moderate doses of opium given with liquid food. After a few days, all fear of peritonitis will have passed. Some prefer not to interfere with the protrusion, in the belief that it will wither up sooner or later, but such a process is tedious, and the application of a ligature to it, moreover, in halves is rarely attended with any risk. If the omentum is much bruised or torn at the time of injury, such injured portions may be cut off and all divided vessels secured.

Treatment.

Protruded bowel uninjured.

When the bowel protrudes through the wound and is *uninjured*, it should be cleansed and *returned under all circumstances*, the wound being carefully enlarged in the course of the muscular fibres for the purpose, should its reduction be otherwise impossible. To facilitate this, the muscle should be relaxed, and the parts last descended, returned first. In returning the intestine the pressure should be directly backwards; if made obliquely, the bowel may be pushed up beneath the fascia or muscles, and thus outside the peritoneum. The wound should be closed by sutures and treated as already described.

When the protruded bowel is *gangrenous*, it must be left *in situ* to slough and that an artificial anus may form, the wound in the abdominal parietes being enlarged; but where there is a prospect of its recovery, the abdominal cavity is its best place.

Protruded bowel and injured.

When the intestine is wounded and the opening a mere prick, through which no intestinal contents exude, the bowel may be returned, a few hours being enough for the wounded part to become sealed by plastic exudation and repair to be completed. When the mucous lining protrudes, the opening should be tied by a single ligature. When the wound is sufficiently *large to permit of the escape of the visceral contents*, it must be stitched up with one of the forms of suture seen in Fig. 35 or 254, cleaned and returned, the ends of the sutures being cut off close.

Wound involving nearly whole calibre.

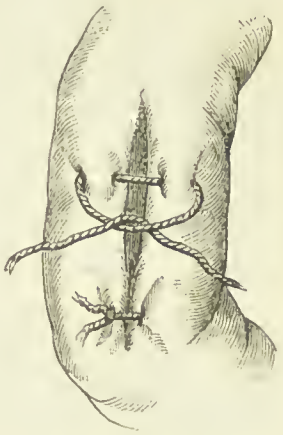
When the wound *involves nearly the whole calibre of the bowel*, it is wiser to stitch the edges of the bowel to those of the wound, thereby making an artificial anus, than to stitch the two divided ends of the intestine together, and to return the whole into the abdominal cavity. Pollock (' Holmes's Surgery,' vol. ii) says, however, if the division be caused by a clean sharp instrument, the extremities may be brought together with sutures and returned; but if the separation be the result of an irregular lacerated wound, as

Sutures.

from gunshot, &c., we should not hesitate to fix the edges to the external wound, and risk the chance of an artificial anus. When the bowel is stitched to the edges of the external wound care should be taken to maintain the line of the canal as much as possible and not to draw the intestine more out of its position than is absolutely necessary. Fixing to external wound.

The general and local treatment of all these cases is similar to that already laid down for the treatment of other abdominal and visceral injuries.

Fig. 254.



Illustrating one form of application of suture to the intestine. The thread is made thick for the sake of clearness.
For another *vide* Fig. 35, p. 146.

Penetrating abdominal wounds complicated with wounds of the viscera, but without protrusion, are, doubtless, far more serious than any that have been hitherto considered, and their effects depend greatly on the condition of the viscus when wounded. Thus the puncture of a *distended* stomach, intestine, or bladder, will to a certainty be followed by extravasation into the abdominal cavity, and, as a result, by great shock and diffuse peritonitis; whereas these organs, when empty, and therefore contracted, may receive a limited injury without any such consequences taking place, *local* inflammation rapidly arising under these circumstances and sealing the wound. Wounded viscera without protrusion. Result.

Nevertheless, remarkable cases of recovery after impalement are on record, and not the least is that of a boy, æt. 11, who fell upon a rick-stake, the stake penetrating his body for seventeen and a half inches. It entered the abdominal cavity in the *right* groin, beneath Poupart's ligament, passed through it to the left side into the thorax, through the diaphragm—displacing the heart and pushing it to the right side of the sternum—into the left lung and passed out of the chest between the seventh and eighth ribs into the axillary space. The stake was removed four hours after its introduction, and not a teaspoonful of blood was lost. Some intestine which protruded from the wound in the groin was replaced, and the inguinal wound stitched up. Opium, with calomel, was freely given subsequently, and in six weeks the boy was able to sit up, play, and eat his ordinary food. Five months after the accident he was free from pain, and able to walk freely. The case occurred in the practice of Mr. Reynolds, of Thame, Oxon, and is recorded in the 'Med. Times and Gaz.,' Sept. 23, 1871. Case.

The chief risks of wounds of the viscera when the solid organs become implicated are hæmorrhage, and when the hollow, extravasation. When the contents of the wounded organ escape externally through the wound, the danger of the case is undoubtedly lessened. When the *stomach* is supposed to be wounded by a puncture the utmost care is called for to prevent the administration of any food; indeed *nothing* should enter the stomach for several days, and life should be maintained by nutrient enemata, because to excite any action of the organ would undo what nature may have done for the Escape of contents through external wound.

repair of the injury, and thus jeopardise life by increasing the risk of extravasation.

When the *intestine* is *wounded* or suspected to have been wounded, the same care is necessary, although ice or iced milk in limited quantities, may be allowed to satisfy thirst.

Opium. *Opium* of course should be given, and is best administered by suppositories—the morphia suppositories of the pharmacopœia being the best preparation to employ in all cases of abdominal surgery. The principles of treatment, however, are the same as have been laid down in former pages.

Wound to be left open. In all penetrating wounds of the abdomen in which any evidence of wounded viscera exists, the *local wound should be left open*, or covered only with a loose covering; for to close the wound so as to prevent the escape of the contents of the wounded viscus externally, would be to close the only gate through which return to health is possible.

Abnormal Anus, Fæcal Fistula.

Fæcal fistula. Confining the term "*artificial anus*" to the surgical operation of forming an anus otherwise than natural for the relief of intestinal obstruction, whether by colotomy or enterotomy, an "*abnormal anus*," or intestinal fistula—*fæcal fistula*—or an unnatural communication between the intestinal canal and the outside of the body, is generally the result of a sloughing or ulcerating bowel in strangulated hernia; although it may occur, either from a wound of the intestine from some external cause, or, from a perforation of the intestine from an ulcerating process originating from within.

When it follows a hernia, the opening is usually at the neck of the hernial sac; when it follows a wound, at the seat of injury; when it is the result of some ulcerative process originating from within, the fæcal abscess may burrow into the pelvis (opening into the vagina, bladder, or even bowel again), or between the abdominal muscles, and make its appearance in the groin, iliac fossa, or loin. When the opening is *large* and *direct* into the bowel it has been called "artificial anus;" when small, indirect, or fistulous, "fæcal or intestinal fistula."

When wound small. The most important point, however, connected with this subject has reference to the amount of intestine involved. When only a small portion of its calibre has been lost, the fistula generally will be small; when a large portion of its calibre or a whole knuckle has been involved, the

When wound is large. fæcal orifice will be large. Under these circumstances the two orifices communicating with the upper and lower ends of the bowel respectively

Position between the two ends. can generally be made out, a fold of membrane formed by the junction of the bent tube standing as a partition between the two portions of the gut. At times, this partition will project so far forward as to close completely the orifice of the lower part of the bowel, and this is the usual state of affairs when a complete knuckle of bowel has been involved in the disease, and under these circumstances a cure by natural processes is almost impossible. At other times, the partition will be but limited, and a portion only of the contents of the bowel will pass externally, the other portion taking its normal course downwards towards the anus, when it is more than probable that nature alone, or but slightly assisted by art, will effect a cure.

Prolapse of bowel. When the orifice is large, there is almost always some prolapse of the bowel. Under all these conditions, the intestines within the abdomen are closely connected by means of adhesions to the external

orifice; the serous surface of the intestine becoming firmly fixed to that of the opening in the abdominal parietes. Beyond these adhesions it is rare to find other coils of intestine adherent about the part; on the contrary, the parts are otherwise usually so free that coils of bowel will be found separating the two portions of intestine that are adherent at the wound, and may so dip down between them as to push forward a serous sac into the artificial opening, and even to form a hernia. The nature of the discharging fluid will fairly indicate the portion of the bowel involved: when well-formed fæces pass, the large or lower part of the small intestine is probably the seat; when the fluid is thin and inoffensive, the jejunum[5] is indicated. The yellow semi-fæculent contents of the ileum can generally be recognised. The nearer the opening is to the stomach the worse is the prognosis, as nutrition under such circumstances must be seriously interfered with. The nearer it is to the lower end of the canal, the better are the prospects of life.

Discharge from bowel a means of diagnosis.

Prognosis.

TREATMENT.—When the orifice is fistulous and the canal below the fistula is fairly open for the passage of fæces, a cure may with some certainty be looked for by natural processes, and such a result is by no means unusual in the artificial anus, which is met with, *after the return of a small hernia into the abdomen*, and particularly of a femoral. In these cases the surgeon has little more to do than to keep up the strength—giving simple nutritious diet, maintaining perfect cleanliness of the wound, and applying gentle pressure to the part. When the fistulous communication is larger, the same treatment must be employed, though with less hope of success. Lawrence recommended the constant use of a truss in these cases to prevent prolapsus, and Pollock strongly advocates the importance of the recommendation, adding, that "a compress of linen placed on the opening, with a larger pad over it, and a truss applied over the whole, will, in a great measure, restrain the contents as well as prevent the protrusion of the bowel." To assist the contraction of small fistulæ, the edges may be cauterized or even pared, a plastic operation being justifiable under certain circumstances.

Treatment.

Palliative.

Use of truss.

With respect to surgical interference in these cases, the recommendations I have to offer are not very satisfactory. Dupuytren suggested an operation to get rid of the projecting fold or septum that has been described. He did this by an instrument called an enterotome, a pair of forceps with one blade grooved, into which the other closed, the approximation of the blades being regulated by a screw. The septum was crushed between the blades and so held till its destruction was effected. The instrument, as a rule, came away about the seventh day, and, Dupuytren says, "by the division and loss of substance, the ridge and the double septum which separate the two ends of the bowel are destroyed so as to re-establish the interrupted communication between them, and restore the natural course of the aliment and fæces." Jobert advises the pressure of the instrument to be gradual, fatal cases having occurred when Dupuytren's rapid process has been employed. The theory of this operation is good; and is based on nature's own processes; for I have seen the septum of an artificial anus ulcerated through, by natural processes, leaving an opening through which fæces passed from the upper to the lower bowel, a narrow band above, alone existing to prevent a freer fæculent flow.

Surgical interference.

Dupuytren's operation. 'Mém. de l'Acad. de Méd.,' 1828.

Success of operation.

The success of the operation has also been good; inasmuch as out of forty-one operations recorded by Dupuytren, twenty-nine recovered, nine were relieved, and three died. In this country, the operation has been little practised. Dr. Buchanan of Glasgow, however, has recorded a successful case. ('Edin. Med. Jour., 1869.)

When fæcal abscess formed.

When a *fæcal abscess* has formed in the abdominal walls, the sooner it is opened the better, and, when opened, the incision should be free. In abscesses connected with the *cæcum* or its *appendage*, this rule is important, and, if acted upon good results may be anticipated. For intestinal fistula opening directly into the *vagina* little can be done surgically beyond attending to the general condition of the patient, giving nutritious food, though not such as is likely to distend the bowel, and observing perfect cleanliness of the passage. The external opening should be enlarged, however, if anything like retained pus exist. Under these circumstances, a natural recovery may take place. In recto-vaginal fistulæ, plastic operations are most successful.

When bowel ulcerated into bladder.

When the *bowel* has ulcerated into the bladder, natural processes appear to be rarely capable of effecting a cure, and, under such circumstances, to save the patient from the miseries caused by the passage of solid fæces into the bladder, the operation of colotomy may be entertained. I have performed this operation on four occasions under these circumstances with success, the operation in all giving great relief.

Colotomy as treatment.

One of my patients is now (1878) alive, free from all pain, the operation having been performed on July 5th, 1870 ('Clin. Soc.,' 1872). In another case operated upon in August 16th, 1869, the gentleman lived to March, 1875, and died from heart disease at the age of 70. The third died from some kidney affection some months after the operation ('Med. Chir. Rev.,' 1869). The fourth died some weeks after, from the cancerous affection for which the operation was demanded, but free from all pain.

Foreign Bodies in the Stomach and Intestines.

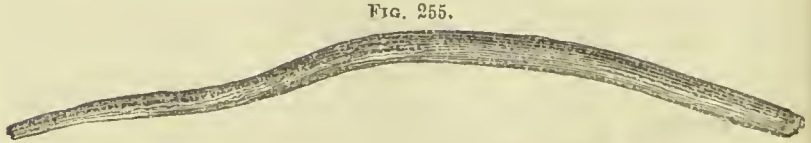
Foreign bodies in the stomach and intestines.

Foreign bodies are often taken into the stomach from accident and design, and the records of cases prove that from the absence or mildness of symptoms, no surgeon should pronounce against the possibility of their introduction. They are passed as often as not per anum without giving rise to very distressing symptoms; although when retained they cause nothing but evil. *Smooth hard bodies* such as coins and stones, as a rule, pass readily without giving rise to any or other than slight colicky symptoms, but *sharp* and *pointed bodies*, such as bones, pins, knives, &c., give rise to such as vary according to the position of the intestines at which they become impacted.

May be ejected by vomiting.

A foreign body taken into the stomach may be ejected by vomiting, discharged externally through the abdominal parietes, retained in the stomach, or passed onwards. In Fig. 255 is illustrated a piece of iron

Fig. 255.



Piece of iron wire discharged from abscess in abdominal walls after having been swallowed. Natural size.

wire that was swallowed by a female lunatic, æt. 56, on March 10th, 1873. The symptoms that followed were so slight, that some doubts as to the occurrence existed, and it was not till May 15th, two months later, when a swelling was detected in the right of the umbilicus, that the history was credited. The swelling rapidly increased and opened on May 20th, and the point of the iron wire projected. This was withdrawn by Dr. T. B. Dyer, the surgeon of Colney Hatch, and a rapid recovery followed, no single bad symptom making its appearance. My friend Mr. Lund, of Manchester, has likewise recorded a similar case in the 'Liverpool and Manchester Med. Surg. Reports' for 1873. When retained, a foreign body may rest without giving rise to very serious symptoms—a rare result—or set up ulceration which may in its turn give rise to a fatal peritonitis. In the more fortunate, it will be passed on through the canal and discharged. Discharged externally.

To prove these points. the reader may refer to Mr. Pollock's article in 'Holmes's System,' vol. ii, where he gives a case in which a lady vomited a gold plate three quarters of an inch long, with two false teeth, after it had been lodged in the œsophagus for nineteen and in the stomach for ninety-seven days. Another case, that of Mr. Taylor's, of Edinburgh, in which a patient *passed per anum*, three days after swallowing it, an artificial plate with six teeth an inch and three quarters long. And a third is on record in which a lady passed per annm, six months after she had swallowed it, a plate two and a quarter inches in diameter with four teeth. May pass per anum.

A remarkable case of this kind has been recently recorded in the Thirtieth Report of the Commissioners in Lunacy, 1876. A woman æt. 43 (having made previously many suicidal attempts), on July 31st, 1875, swallowed thirteen screws, each screw consisting of a body 2½ inches long and ½ inch thick, a raised collar nearly ¾ inch in diameter, and a square head; the whole thirteen screws weighing 24 ounces. She was fed on pudding and gruel, morphia was injected subcutaneously to relieve pain, and, after a few days ounce doses of castor oil were given daily. On the forty-first day, the first of the screws passed by the bowel, and, by the end of the sixth month, the last came away. The screws in their passage had lost 4¾ ounces in weight. This case occurred in the Bristol Asylum, under the care of Dr. Thompson. Poland has also recorded in his prize essay the case of a lunatic who died from ulceration of the duodenum owing to the pressure of a spoon handle that had been swallowed about three months before, with *thirty* others, besides nails, pebbles and pieces of iron. These foreign bodies were extracted from the stomach after death, and weighed in all forty ounces. The most conplete list of cases of foreign bodies in the digestive canal will be found in the 'Union Médicale' for November, 1874, by Dr. Mignon.

In Guy's Museum (Prep. 1800) there is an enlarged and thickened stomach of a sailor who had swallowed clasp knives. He was æt. 23, and in June, 1799, he swallowed four clasp knives which were discharged from the bowels. In March, 1805, he swallowed from fifteen to twenty more, after which his health became impaired. He vomited the handle of one and passed portions of the blades of others, and in March, 1809, died in a state of exhaustion. After death one blade was found perforating the colon opposite the kidneys, but without extravasation of fæces, and another was fixed across the rectum. In May be retained.

the stomach, too, were numerous blades partially dissolved, or between thirty and forty fragments in all.

Concretions. At times, intestinal calculi form from the agglomeration of hair, husk, particularly oat husks, or other foreign substances, and prove fatal. Dr. Down has recorded such a case ('Path. Trans.,' 1867), in a boy, æt. 13, who died of exhaustion after 15 days' illness. Not many years ago I saw an artist, æt. 36, who died from intestinal obstruction, through whose abdominal walls a globular indurated mass was readily felt on the right of the umbilicus. I suspected it to be made up of hair, for he was in the habit of sucking to an excess the paint brushes of his pupils, but the diagnosis could not be verified after death.

Treatment. TREATMENT.—Rest in the horizontal position and expectant treatment are in these cases the two essential points to be observed, and purgatives should on no account be given. The "smasher," according to Pollock, who constantly swallows false coin, when caught in the act of passing it, avoids *purgatives*, but takes a constipating diet, such as hard-boiled eggs and cheese, together with his usual food, thinking that the money is more likely to be caught and consequently passed in a bulky stool than in a liquid one. The surgeon should act on this principle. When the foreign body becomes impacted in the stomach or intestine, or sets up inflammatory action and peritonitis, the thought of opening the abdomen may be entertained; that is, the surgeon may assist natural processes when they are doing their best to get rid of the foreign substances by ulceration, and, when the foreign body is large and clearly cannot be passed, the surgeon should open the stomach by *gastrotomy*. ten cases out of eleven in which this operation has been performed having recovered. (*Vide* paper by Dr. Pooley, of New York, 'Richmond Med. Journ.,' April, 1875.)

Gastrotomy and Gastrostomy.

Gastrotomy and gastrostomy. When the stomach has to be opened for the removal of a foreign body the operation is rightly described as that of "gastrotomy." When the same operation is performed with a view to establish a permanent fistula for the introduction of food, as first performed by Sédillot in 1849, and described by him as gastro-stomie, the term "gastrostomy" seems to be the more applicable term. This change has been suggested by Dr. Pooley, of New York, and it seems so apposite that I now adopt it.

That the operation of gastrotomy is not necessarily fatal is proved by the fact, that it has been performed at least eleven times, and in ten with success, and though in the twenty-one cases in which gastrostomy has been undertaken for cancer, life has been never prolonged for more than forty days (Sydney Jones' case, 'Lancet,' May 15th, 1875), the evidence of the relief that it has afforded to those who have been subjected to it is sufficient to prove that it is based upon a sound principle and a humane practice, for it ought to be remembered that in the twenty-one cases in which it was performed, it was undertaken more with a view of mitigating the horrors of a death from hunger and thirst, and of prolonging what remained of life than from any curative object, for in every instance the cause of the obstruction was cancerous stricture of the œsophagus. I have had an opportunity of watching the progress of three of these cases under the care of my colleagues, Messrs. Cooper

Forster and Durham, and of two under my own eare; and I am free to aeknowledge that the advantages given by the operation are worth the risk, and that if life were not prolonged, it was eertainly rendered more endurable.

Wheu, however, the operation is performed for a eicatricial stricture, better results may be expected, as proved by the records of the following interesting cases, operated upon at Rostock by Dr. Trendelenburg, March 8th, 1876 ('Med. Record,' March. 1878); and in Paris by M. Verneuil ('Gaz. des Hôp.,' Oct. 28th, 1876; 'Lancet,' Jan. 13th, 1877).

Trendelenburg's case for cicatricial stricture.

Trendelenburg's case was in a lad who had swallowed some snlphuric acid six months previously, and the strietnre was in the lower end of the gullet. An incision was made parallel to and one inch below the left ribs, and a very small opening into the stomach. The sutures were passed through the whole thickness of the abdominal parietes and stomach, and a rapid recovery followed the operation. At the end of the fifth month the weight of the boy's body had increased by one fourth. The boy took food as usual by the mouth, masticated it, and then blew the contents of his month through a long elastic tube directly from the month into the cavity of the stomach.

Mode of feeding.

Verneuil's case.

Verneuil's patient was a mason æt. 17, and the stricture a cicatricial one, due to the accidental swallowing of some caustic potash on February 4th, 1876. Œsophagotomy was out of the question, as the stricture was situated low down in the tube, and relief was called for because swallowing was impossible. On June 26th gastrostomy consequently was performed, and a rapid recovery followed. The man was up and about on August 20th. A caoutchouc sound was kept in the wound for feeding purposes. In the report of the case it is stated that when food is poured into the stomach the only sensation experienced is that of heat or cold. Saliva, however, is at the time freely secreted, and the man executes masticatory movements. Digestion goes on well without the aid of saliva.

These cases are most satisfactory, and are sufficient to encourage the belief that better success would follow this operation even when undertaken for cancer, if it were performed at an earlier period of disease than has hitherto been the practice.

Arguments in favour.

We perform colotomy on a patient with cancerous stricture of the intestine or other mechanical obstruction without hesitation, and surgeons are now willing to admit the great advantages afforded by this means. Surely the advantages offered by gastrostomy for stricture of the œsophagus, cancerous or otherwise, are not less potent, and *should it be undertaken before the patient's powers have been brought to too low an ebb*, there is no reason why it should not be equally effective. In one of my own cases the man lived five days, and the operation had nothing to do with the death, there being no peritonitis, and the local repair was most complete. In the second case the patient lived two days. The operation has not hitherto, I believe, been successful, because it has been put off until too late; so also was colotomy unsuccessful till it was undertaken at an earlier stage of the disease. If gastrostomy has the same chance as colotomy now has, it will become as established an operation in surgery.

Description of the operation.

The operation.—Chloroform had better be given, as it is important that absolute quiet be maintained during the operation, although the risks of vomiting as a consequence are not slight. The patient should

be placed upon his back, and an incision made on the left side below the ribs, the object being to find the cardiac end of the stomach in preference to the pyloric. The line of the linea semilunaris is that usually selected for the incision—a cut three or four inches long being made through the tissues seriatim down to the fascia lining the muscles—every vessel being twisted or tied as it bleeds; but, in my own operations I make an oblique incision along the lower borders of the ribs, commencing at the linea semilunaris, and I do so with the view of catching the cardiac end of the stomach, and I may add that I pick up the stomach with my fingers very readily. The fascia and peritoneum can then be divided. With the thumb and finger the stomach can now be sought, and held when caught. This is best effected by the passage of a Liston's needle armed with a long double silk ligature through the margins of the wound and the stomach's coats, and a second about three quarters of an inch lower down. The surgeon has then to fasten the stomach to the margins of the wound, and for this purpose the quill suture seems to be the best. The stomach should then be opened over the ligatures that have been passed through it by an incision being made in the line of the wound; the centre of the double ligatures will then become exposed, and these should be drawn well out and divided. There will then be two double ligatures through each side of the opening in the stomach and the margin of the wound. On tying the two ends over two pieces of bougie, one introduced against the inner surface of the stomach, and the other upon the integument, the parts are secured, the bougies admirably compressing the thin walls of the stomach against the integuments, and retaining them there. One or two other sutures will probably be required to close the wound, and an additional one at either end of the opening in the stomach to keep it in its place; the operation is then complete. When the quill suture is not used, the stomach must be stitched to the margins of the wound in the ordinary way, but a more accurate adaptation of the parts and greater security is acquired by the quill suture than any other, and what is more, the pieces of bougie are capital guides to the orifice into the stomach, the slightest traction upon them rendering it patent for feeding purposes; and with this object one of the sutures should be left long on either lip of the wound. After the operation, it is advisable to desist from giving food for a few hours, in order to give the stomach rest; although, after a day or so, liquid nourishment may be administered in small quantities through a tube, milk and eggs being probably the best, or milk alone. Where enemata can be tolerated they should be used. Care must be observed that too much food is not given as it retards progress, a quart or three pints of milk in twenty-four hours being sufficient. The edges of the wound should be carefully protected by oiled lint. The sutures may probably be removed wholly or in part on the fifth or sixth day. Schönborn, of Königsberg, advises the early performance of this operation while the stricture is still passable to small bougies and to facilitate the operation, advocates the use of a hollow bougie with a child's india-rubber ball on its top, which should be introduced by the gullet, and blown up in the stomach. This suggestion seems worthy of adoption when it can be acted upon.

Oblique incision recommended.

Mode of fastening stomach to parietes.

Mode of opening stomach.

After-treatment.

It must be added that Sédillot was the first surgeon to perform the

operation in 1849, and Mr. Cooper Forster, on the suggestion of Dr. Habershon, was the first to do it in this country in 1857. Since then Mr. Sydney Jones, Fenger of Copenhagen, Lanvielonque of Bordeaux, Durham, Le Gros Clark, Mac Cormac, T. Smith, V. Jackson, and myself, have had cases, making twenty-one in all.

When a foreign body becomes *impacted in the small intestine*, and life is threatened, it is a question how far the surgeon is justified in attempting its removal. I can see no reason why an attempt should not be made, when the course of the case has proved that natural processes are incompetent to rid the offending body and life is threatened by its presence.

When the *colon, cæcum, or its appendage*, is the seat of impaction there is less objection to the attempt, for as *colotomy* is now known to be a valuable operation for cancerous or other obstruction of the rectum, and in cases of suppuration about the cæcum free incisions in the iliac fossa are of proved value, so laparotomy is not less likely to prove of service when the obstruction is caused by the presence of a foreign body.

Intestinal Obstruction.

When body impacted in intestine. Mischief of delay.

In cases of acute or chronic intestinal obstruction when the physician's art has failed to give relief, the surgeon's aid is occasionally required, and it would be well for the medical mind to recognise the fact, that in a large proportion of instances, this aid is sought at too late a period—that is, when the patient's powers have become so exhausted as to exclude all hope of a successful issue being obtained by any treatment—or, when the involved tissues have undergone such changes from peritoneal complications as to forbid any reasonable expectation of the competency of nature's reparative powers to effect a cure; as cases of *acute* intestinal obstruction, like those of strangulated hernia, require prompt and active treatment if they are to be successful, while those of *chronic* obstruction require a no less decided line of action. It must be admitted, however, that there is no class of cases which claim for diagnostic purposes more thought and judgment, the difficulties of diagnosis as to the cause of the obstruction being sometimes great; the question of operative relief has consequently to be decided upon uncertain grounds.

Difficulty of diagnosis.

Yet, when the diagnosis is clear and the nature of the case decided, delay is dangerous, and a want of courage to act upon the diagnosis is criminal in the surgeon. The question of diagnosis is consequently all important, and will first claim attention.

Diagnosis.—In a clinical point of view, cases of intestinal obstruction may be divided into *acute* and *chronic*. The *acute*, include strangulation of a portion of bowel from internal hernia, omental, mesenteric, peritoneal, or fœtal bands, or twists of the intestine (volvulus). The *chronic:* inflammatory or cancerous strictures of the large or small intestine; the occlusion of the bowel from the mechanical pressure of tumours; adhesions of the intestines from chronic inflammatory peritoneal or former acute changes; and last, but not least, the impaction of fæces.

Perityphlitis and acute peritonitis due to perforation may also simulate the acute form. Intussusception belongs to both divisions, because when strangulated they may give rise to acute, and when incarcerated, to chronic symptoms, although the symptoms in their onset are always sudden. The relative frequency of these conditions will be seen in the following table:—

CAUSES OF INTESTINAL OBSTRUCTION, EXCLUDING HERNIA.

Being an analysis of 124 consecutive cases extracted from the post-mortem records of Guy's Hospital, by Dr. Hilton Fagge, from 1854 to 1868 ('Guy's Rep.,' 1868); and Mr. Russell, from 1868 to 1876 (unpublished).

Guy's Cases.

- 33 . **Acute obstruction** .
 - 1 Internal hernia.
 - 7 Twists (volvulus).
 - 25 Bands.
 - 14 Lymph.
 - 6 Diverticula.
 - 2 Appendicæci.
 - 2 to neck of hernial sac.
 - 1 from pedicle of ovarian tumour.
- 76 . **Chronic obstruction**
 - 3 Fæcal impaction.
 - 3 Mechanical pressure of tumours.
 - 47 Stricture .
 - 2 Small intestine
 - 45 Large
 - 33 Rectum and sigmoid flexure
 - 7 Transverse colon with hepatic and splenic flexures . . .
 - 5 Cæcum or ileo-cæcal .
 - 23 Matting together of intestinal coils from peritoneal and cancerous disease. (Contractions.)
- 15 . **Intussusceptions** .
 - 2 Rectal.
 - 7 Ileo-cæcal.
 - 6 Small intestine.

124

Analysis of 63 cases of Stricture of Intestines as given in a Paper by Coupland & Morris. ('Brit. Med. Journ.,' Jan. 26, 1878.)

	Middlesex Cases. 28 Large Intestines, 3 Small.		Pathological Society. 31 Large Intestines, 1 Small.		General Total.
33 Rectum and sigmoid flexure	24	.	21	=	78
7 Transverse colon with hepatic and splenic flexures . . .	3	.	9	=	19
5 Cæcum or ileo-cæcal .	1	.	1	=	7
					104

In all cases of intestinal obstruction the diagnosis should be made upon the principle of exclusion, the practitioner coming to a conclusion by first running over every possible cause, and eliminating each seriatim, and subsequently weighing the points in favour of the probable cause.

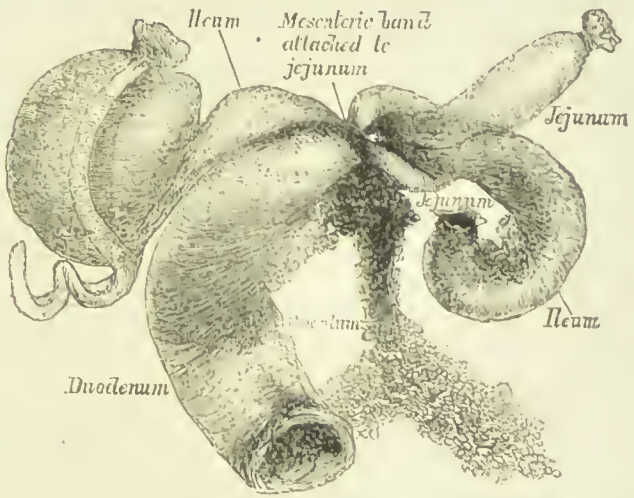
The possibility of the symptoms being due to a strangulated or incarcerated external hernia should always be carefully investigated. Always look for hernia.

Acute Internal Strangulation of the Bowel,

whether from an internal hernia, twist (volvulus) or a fœtal or peritoneal lymph band, may take place at any period of life, and the symptoms to which it gives rise are those of an acute strangulated external hernia, viz. sudden and definite onset of the illness in a healthy subject, severe paroxysmal central abdominal pain attended by sickness and more or less collapse; constipation, inability to pass wind downwards, and hiccough; occasionally also scanty urine, or even its suppression, and visible coils of distended bowel. Symptoms of acute obstruction.

There will, however, be no abdominal tumour, no tenesmus, and no hæmorrhage from the bowel.

Fig. 256.



Case of strangulation of the bowel by lymph-band constricting ileum about three inches from cæcum and a coil of jejunum. Taken from a man, æt. 26, who died after bowel obstruction of 15 days' duration. This case occurred in my father's practice in 1838, and is recorded in 'Trans. Med. Soc. of London,' 1846. The suggestion was then made of operative interference.

When, therefore, a case presents itself with these symptoms there can be no difficulty in coming to a conclusion as to its nature, although it may be difficult, if not impossible, to diagnose the precise cause of the strangulation. If, however, we refer to the table at page 620, some guide will be found, for it will there be seen that out of 33 cases 25 were due to bands, 7 to volvulus, and 1 to internal hernia.

When there has been a history of old hernia, the probabilities of the existence of a band are much enhanced, since it is true that with hernia such bands are not uncommon. Duchaussoy, in his paper "On Internal Strangulation" ('Mém. de l'Acad. de Méd.,' 1860), gives such cases. Fagge quotes one, and in my own practice three have occurred; one Examples.

died unrelieved; in the second, I opened the empty hernial sac, and so enlarged my incision upwards for about two inches as to detect a band high up in the abdomen, which I divided with a pair of scissors, and a perfect recovery took place. This case occurred in the practice of Dr. Wilkinson, of Sydenham, and is fully recorded in the 'Med.-Chir. Trans.' for 1867. The patient is still alive. The third died after the operation, but the band was divided and a large coil of intestine released. The operation had been delayed too long.

Analysis of 148 cases.

Mr. Gay's analysis of 148 cases tells us that 102 were in the male and 46 in the female, and that the largest number of cases took place in patients between 15 and 35.

The surgeon, under the circumstances related, however, has a clear case and an important decision before him, for if the diagnosis be correct, and a portion of bowel is *strangulated* within the abdomen, obstructed by some solitary band or twisted, he knows that very little can be looked for by medical treatment—that by leaving things alone, and the case is unrelieved, death is inevitable; and he is aware, moreover, that the hope of a cure by natural processes is very meagre; and if I estimate that hope as being nearly on a par with that entertained in a case of ordinary strangulated hernia when left to itself, I shall probably be about the mark, since cases of strangulated hernia do *occasionally* go up of themselves when all surgical efforts to reduce them have failed less than herniotomy; and, cases of internal strangulation, from whatever cause, do *occasionally* free themselves. Nevertheless, no prudent mind, on the strength of these exceptional occurrences, would willingly leave a case of external strangulated hernia to itself with the vague chance of its self-reduction; and I think that no prudent surgeon ought to leave any case of internal hernia or strangulation unrelieved with the same almost forlorn hope; because, granting that the diagnosis of the case can be made, by no medicine, no manipulation, no expectant treatment can the mechanical obstruction be overcome, and, under these circumstances, a fatal termination must be anticipated.

Opium may relieve pain, mask symptoms, and give rise to a pleasing delusion that all is doing well in cases of internal strangulation, as it is well known it does in others of external hernia; but in the one, as in the other, it does no more. It does not accomplish the only true remedy—viz. relieve the mechanical strangulation to which the bowel is subjected.

In external hernia, the only recognised correct treatment is herniotomy, and I submit that in internal hernia or its equivalent the only sound practice is "laparotomy."

The operation of ovariotomy has proved to us, that the exposure and manipulation of healthy intestine is not of itself a fatal measure, and there is every reason to believe that in the cases now under consideration, a good result might often be secured if the operations were performed before a fatal peritonitis had set in or the strangulated bowel been injured past recovery. At any rate, as matters now stand, a recovery by medical treatment from an internal strangulation is a matter of wonder, and it would be well, as all collateral experience indicates, that a bolder practice should be employed.

If we appeal to pathology, and it is only there unfortunately that we can appeal, we receive ample facts, since Dr. Fagge, in his able article already referred to, tells us that "there might in many cases have been

A HELP TO DIAGNOSIS IN CASES OF ABDOMINAL OBSTRUCTION.

"Let no one set too much value on any one sign or symptom."—FAGGE.

	Acute—	Chronic Obstruction—		Acute or Chronic—
	Obstruction or Strangulation.	From Disease of Large Intestine.	From Disease of Small Intestine.	Intussusception.
Previous condition of subject	In good health	Ailing for some time with abdominal symptoms.	Ailing, with previous attacks of incomplete obstruction.	In good health.
Mode of attack	Very sudden and acute	Symptoms gradually increasing in severity, or acute grafted upon old.	Paroxysms of colicky pain, upon old symptoms.	Sudden onset, and increasing when acute, subsiding when chronic.
Early symptoms—				
Pain	*Abdominal pain*—fixed, central and paroxysmal.	*Pain* diffused and increasing with distension.	*Pain*—paroxysmal, with intervals of ease and hypogastric.	*Pain* fixed and often relieved by pressure.
Vomiting	*Vomiting* rapidly becoming fæcal.	Intermittent and fæcal towards the last.	Occasional during attack of pain.	Rapidly becoming fæcal in acute cases, absent or intermittent in chronic.
Collapse	*Collapse* very marked	Absent till the end	Absent till late.	Very marked in acute cases, not so in chronic.
Constipation	Absolute constipation and inability to pass flatus.	Gradually increasing in severity.	Attacks of constipation, alternating with natural relief.	Occasionally present, but as a rule "dysenteric" symptoms, straining, tenesmus, muco-sanguineous stools, or hæmorrhage.
Abdominal distension	Rapid and severe, central and hypogastric.	Gradually increasing, lumbar and epigastric	Never great, increased during attack.	Rarely severe.
Manipular indications	Tympanitic, distended coils at times to be felt.	A fixed swelling at times to be felt in either iliac fossa.	A doughy condition of bowel, becoming knotty during attack.	Distinct tumour often to be felt, its shape varying during attack.
Visible indications	Abdomen tense in umbilical and hypogastric regions, with visibly distended coils.	Abdomen broadly distended, coils of intestine visible.	Coils of intestine, very visible.	Nothing marked to be seen.
Peristalsis	Rarely visible	Marked	Very marked	Not visible.
Urine	Scanty or suppressed	Natural in quantity	Natural	Natural.
Rectal examination	Lower bowel probably quite empty.	Stricture of bowel may be felt in rectum or in sigmoid flexure by manual examination.	Nothing abnormal	Rectum may contain mucus or invaginated bowel.

no little difficulty in finding a band among the distended coils, but I regard the facts derivable from our post-mortem records as indicating no insurmountable obstacles to the success of an exploratory operation in the great majority of the cases of true internal strangulation, which are to be found in these records." Dr. Brinton, in his analysis of 600 cases, points also to the same conclusions. Under these circumstances, I feel bound to express my conviction, that on the diagnosis being made of an internal strangulation, from whatever cause, the operation of "laparotomy" should be performed. But this operation is not to be performed as a "dernier ressort" more than that for external hernia, but should be carried out as early in the progress of the case as the diagnosis will justify—when, in spite of the gravity of the measure, good results may be looked for.

Chronic Intestinal Obstruction

now claims attention, and it is to be observed "in limine" that the clinical history of these cases is very distinct from that of the acute; for, whereas in the latter, the symptoms appear, as a rule, suddenly in patients who have been apparently in good health—in the former it will almost always be found that there has been for a more or less lengthened period some abdominal pain or symptom; some difficulty in obtaining a movement of the bowels or in the act of defæcation—some discharge probably of glairy mucus, of pus or of blood, separately or combined at uncertain intervals; and last, but not least, some change in the form and character of the stools, the motions at one time being liquid and loose, at another hard and marble-like, while at intervals they are pipe or tape-like. Under all circumstances there must be symptoms of long standing, and, if more acute symptoms exist when the case comes under notice, they will be found to have been grafted upon the old. If, therefore, we are called to see a patient suffering from marked symptoms of obstruction of some days' duration, and obtain such a history of the case as has just been sketched, and find him with abdominal tympanitic distension and probably pain, possibly visible peristalsis, nausea, vomiting, hiccough and borborygmi, we may safely come to the conclusion that the case is one of chronic obstruction, and that it has for its cause one of those named in the table (page 620). It will prove to be either stricture of the colon or rectum, the mechanical pressure of a pelvic or abdominal tumour, the matting together of the intestinal coils from old or chronic inflammation of the peritoneum or meseutery, or from cancerous abscess; and last but not least, to fæcal accumulations, and in every case of obstruction the last possibility being the cause should be borne in mind. Rare instances are also on record in which other causes have existed; and I have given in the chapter on hernia, some in which the obstruction had been clearly traced to the influence of an adhesion between the bowel and a hernial sac or some part of the abdominal parietes, or to an obstructed obdurator or other hernia.

Now the effects of obstruction, from whatever cause, are very uniform, and terminate fatally from either exhaustion or peritonitis if the obstruction is not overcome; the chronic peritonitis being directly due to the obstruction, and the acute to either a perforating ulcer of the sigmoid flexure secondary to the stricture, to some ulceration of the cæcum or colon, the result of the overdistension, or to the

mechanical rupture of the cæcum the direct result of the pressure of the fæcal accumulatiou acting backwards upon the cæcal cul-de-sac, my notes describing two cases in which the cæcum burst; one in which it was purple in colour, and measured fifteeu inches round; aud auother in which it had sloughed. I have also notes of a case of male child born with an imperforate rectum, who died ou the sixth day from ruptured cæcum. And out of elcven consecutive fatal cases of untreated stricture of the rectum at Guy's Hospital collected by my dresser, Mr. Russell, death was caused by ruptured cæcum in threc, by perforation of the sigmoid flexure iu two, by peritonitis after punctnre to relieve flatus in one, and by exhaustion in three. Heuce the importauce of early relief before these changes have been started. These poiuts have been ably brought out in Couplaud and Morris's paper. Ruptured cæcum.

To diagnose thc true eause of the obstruction is therefore the surgeon's next aim, and it would be well if I were ablc to add that the task is au easy oue; but such is not the case. It is true wheu the obstruction is in the rectum that a digital exaniination of the part may find it out; wheu in the sigmoid flexure that the cautious introduction of the whole hand into the reetum (after the uethod of Simon, of Heidelberg) may detect it, and that when a tumour is to be felt by palpation to the left of the umbilicus through the abdominal walls the probability is suggested of the disease being iu the colon, but without these guides little definite knowledge is to be obtained by either palpation or percussion; by the passage of the long tube or by the amount of fluid that may be injeeted into the colon.

Under these circumstances, therefore, the surgeon is throwu baek upon the probabilities of the case as read by the light of pathological knowledge and it is gratifying to be able to show that these facts speak with no uncertain sound. Indeed, they speak so strongly and decidedly, that the surgeon may rely upou them with confideuce, and base his practice upon their indicatious.

The facts are revealed in the table to which I have already drawn atteution. Thcre it will be seen that out of the 76 fatal cases of chronic obstruction 3 were due to fæcal impaction, 3 to the mechanical pressure of tumours; 23 to what Dr. Fagge described as "contraction" caused by the matting togcther of the intestinal coils from peritoneal or eancerous disease, and 47 to strictures of the bowel.

Now, cases of fæcal accumulation do not require any lengthened treatment in these pages; when they come under the surgeon's care as examples of obstructiou they arc to bc treated by the mechanical removal of the fæces from the rectum by such meaus as the finger, the lithotomy scoop or the handle of au iron spoon—these ueasures being aided materially by the free use of grease, oily enemata and medicines. Fæcal accumulation.

The fact that fæcal accumulatiou may give rise to the worst symptoms of uechanical obstruction and even to death should always be before the surgeon, and induce him to examine the rectum with care in all probable cases.

Obstructions due to the presence of some abdominal tnmonr, hydatid, canccrons, ovarian, or otherwise, are to be diaguosed and dealt with on their own merits, although wheu it is the lower part of the bowel that is obstructed, right or left lumbar colotomy should uot be ueglected when other means of relief are not available. I have performed this operatiou on most occasions from such a cause with gratifying success. Obstruction due to tumour.

Diagnosis between stricture and contractions.

We come now to the two larger divisions of cases, viz., those of *stricture* and of *contractions*, and a very little consideration will show that these cases have as distinct a clinical history as they have a pathology, and that they, moreover, require a distinct line of treatment.

With respect to their pathology it may at once be stated that "contraction" is the cause of chronic obstruction of the small intestines, and "strictnre" of obstrnction of the large bowel.

That the cases of "contraction" are due to the matting together of the intestinal coils from more or less diffnsed inflammatory or cancerons peritoneal disease, while cases of stricture are due to a local narrowing of the bowel from disease of its coats.

In the cases of "contraction" the action of the intestines (small or large) is interfered with from adhesions or from a bending or doubling of the bowel npon itself, and conseqnently there is an interference with the peristaltic movements. In those of "stricture" the action of the bowels is prevented from the direct mechanical obstrnction occasioned by the strictnre.

The clinical history and symptoms of these two classes of cases consequently differ.

In the case of "contraction" the symptoms are clearly referable to a difficnlty in the passage downwards of the intestinal contents; in that of "strictnre" to a difficnlty in defæcation.

In the former case the symptoms are attacks of griping colicky abdominal pain, irregnlar and incomplete intestinal evacnations, and the painless discharge of healthy motions. In the latter there is mostly an absence of abdominal pain beyond that due to distension, more or less complete constipation, alternating with looseness of bowels, the occasional or frequent mixture of mncns or blood with the motions and painful defæcation.

In "contraction" when sickness exists it will be passing and lasting only during the attack of colicky pain. In "strictnre" it will occur towards the close of the disease when the obstrnction is more complete.

In "contractions" the abdomen probably will not be mnch distended and if it be so, only dnring the attack, the distension, moreover, will be central and hypogastric. "The intestines will then," writes Fagge, "be seen writhing and coiling, and a gurgling of fluid is heard; there will also be visible distinct peristaltic movements of the intestines." In "stricture" the abdomen will to a certainty be distended and the distension will be lnmbar and epigastric; large coils of distended bowel will also be visible with peristaltic movements, the visible peristalsis in both cases being dne to the chronicity of the affection and consequently to the hypertrophy of the bowel from overwork.

Snch then are the broad points of distinction between the two large classes of cases of chronic intestinal obstrnction, and they are enongh to gnide the snrgeon in his practice. At times, however, the distinctions fail. Indeed, when the history of a case of either contraction or stricture is deficient, the diagnosis is most difficult, and if seen when the symptoms are at their height one or other may be mistaken for cases of acnte obstrnction, the chronic symptoms of which nothing can be known, having lighted np into the visibly acute, in the same way as a case of incarcerated or obstrncted hernia may snddenly develop into one of acnte strangulation.

Having then thus mapped out the chief points of distinction between the two classes of cases of chronic intestinal obstruction, and bearing

in mind that in the "contractions" the small intestines are the parts that are involved and in the "strictures" the large, it remains for the surgeon in the latter class of cases to determine the seat of the disease, for a correct knowledge upon this point is clearly requisite before any precise operative treatment can be entertained. On reference to the table, this point comes out very strongly—for out of 104 cases which have been tabulated, in 78 the disease was in the sigmoid flexure or rectum; in 19 it was in the colon or one of its flexures; and in 7 it was about the cæcum. In three fourths of the cases the disease was consequently below that part of the bowel that would be opened by left lumbar colotomy, and in about one fifth by right; in but a very insignificant number was it higher up. Seat of stricture.

With these hard facts before us, the conclusion seems tolerably clear, that in all cases of obstinate constipation due to mechanical obstruction in the large intestine, when medicinal treatment has failed, and the removal of the disease by operative measures is out of the question, instead of wasting valuable time by the persistent administration of aperients which must do harm, of enemata which can do no good, of opium and allied remedies which only mask symptoms and mislead the practitioner colotomy should be performed. In the *left* loin, when the diagnosis has been made of disease of the rectum or sigmoid flexure, and in the *right* when the exact position of the stricture cannot be determined; for from our table it would appear that in not one case in fifteen is it likely to be above this point; right lumbar colotomy also so far as the relief it gives is as satisfactory an operation as left. It must be stated, moreover, that this relief should not be postponed too long, because from the facts alleged the operation will be of little avail when from the mechanical effects of the fæcal distension a peritoneal inflammation has set in, or changes have taken place in the cæcum or large intestine of an ulcerative or inflammatory character. Colotomy in stricture.

With respect to the treatment of "contractions," much may be done by judicious medical measures, more particularly by helping the passage onwards of the contents of the intestinal canal, by means of laxatives, those of an oily kind being the best, such as the oily mixture of the Guy's Pharmacopœia. Treatment of contractions.

A time will, however, come when these means will fail and others must be looked for, unless the patient be left to his fate; and of these "enterotomy" is most applicable. The operation consists in opening the small intestine in the right or left iliac fossa, and so establishing an artificial anus. Enterotomy.

The operation will be considered further on.

Intussusceptions,

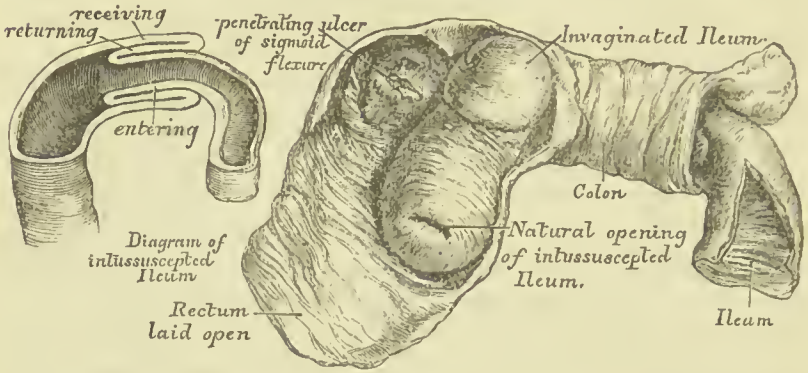
or the invagination of some portion of the bowel into a lower segment (Fig. 257), may occur at any period, though more common in infancy and child life. They may take place also in any part of the intestine—my table recording that out of the 15 cases tabulated, 2 were rectal, 7 ileo-cæcal, and 6 small intestine. These statistics are supported by Gay's analysis of 74 cases, in which 8 involved the large intestine alone and were colic, 33 ileo-cæcal, and 33 small intestine. The rectal variety is, however, more frequently found in the adult, the iliac in young adults, and the ileo-cæcal in infancy and childhood. When the invaginated portion of intestine becomes *strangulated*, the symptoms are acute; when simply *incarcerated*, they may Intussusception. Strangulated or incarcerated.

be chronic. Sudden invasion of symptoms, however, is the rule in both forms, with tenesmus and muco-sanguineous discharges, more particularly when the ileum is involved; discharge of blood per rectum occurs in the acutest cases.

Symptoms.

The symptoms may be very acute and destroy life in three days, or so mild as to be only those of intestinal irritation. The development of symptoms as well pointed out by Mr. Howard Marsh ('St. Barth. Rep.,' vol. xii, 1876, p. 98) depending upon the occurrence of con-

FIG. 257.



Intussusception, with diagram showing the entering, returning, and receiving layers of ileum into colon.

striction—an intussusception in this respect being like a hernia, which may be "down" without being strangulated or even obstructed—the various symptoms in each case depending, not on the mere displacement of the intestine but on the constriction produced by the displacement.

Diagnosis between band and intussusception.

When *acute*, a case of intussusception at its onset may be mistaken for one of "band," and yet marked points of difference exist between the two. In both, the attack is sudden, and followed by collapse, but in the case of a *band*, pain is localised from the first, is paroxysmal, and remains severe to the last, and is also unassociated with tenesmus. In the *intussusception*, pain varies much both in seat and intensity, is often relieved by pressure, and towards the last ceases. The pain is likewise commonly associated with tenesmus. In "band," vomiting soon becomes fæcal and is constant; in intussusception it may also be the same, but it as often ceases. In "band," constipation is the rule, with inability to pass flatus; in "invagination" diarrhœa, tenesmus and bloody mucoid stools are characteristic; constipation is, however, at times present in chronic cases. In "band," central and hypogastric abdominal distension is an early symptom, in "intussusception," it may never exist. In "band," the most that may be felt is a single coil of distended bowel; in "invagination" a distinct tumour may be felt.

Dr. Leichtenstein, of Tübingen, in a valuable analysis of 593 cases of this affection ('Prager Vierteljahrschrift,' Bd. 119, 121, 1874), informs us that when a tumour is recognised in the epigastric region, the ileum is probably the part invaginated; when in the right iliac fossa the ileum into the cæcum; and when it can be felt in the rectum it is probably ileum. Mr. Morris ('Path. Trans.,' p. 133, 1877), has, however, pointed out the possibility of mistaking blood clot in the rectum for the lower end of intussuscepted bowel, so that the use of the

speculum should be brought to the aid of the finger in any case of doubt. Leichtenstein says also that when the intussuscepted portion of bowel sloughs off it occurs between the eleventh or twenty-first day from the beginning of the disease, and that it is generally part of the ileum. This result, however, is very rarely met with in infancy.

Treatment. In the treatment of intussusception, operative interference is not to be undertaken in a hurry, as it is not to be questioned that cases of this affection constantly occur which right themselves either by or even without the aid of medical or surgical treatment, the bowel either freeing itself by an unexplained process, or, in some acute cases sloughing away, and a so-called cure resulting. Fagge, however, well observes upon this point that "when this cure by expulsion occurs it frequently only postpones the fatal termination instead of entirely preventing it. The patient dies some months afterwards from contraction of the cicatrix which had formed at the seat of the disease, this fact affording a weighty additional argument in favour of an attempt to explore and pull out an ileo-cæcal intussusception when the case is correctly diagnosed at an early stage." Mr. Morris says "It would appear that when small intestine is intussuscepted into *small* intestine the *invaginating* portion, owing to its small relative size, is too much damaged by compression from within to allow of recovery by expulsion of the reflected and entering portions."

No operation should, however, be thought of in intussusception until well-considered minor measures have been employed and failed, care being taken that too much time is not expended in the attempt. In *acute* intussusception, however, where the bowel is clearly strangulated, but a few hours should be given, because unless relief is speedily found, death ensues, and the younger the patient the more rapid the result. Of acute.

In *chronic* intussusception where the bowel is probably only incarcerated, the surgeon should not withhold his hand for more than a week; because if relief is to be obtained by treatment, it should be obtained within the seven days it is justifiable to expend in the attempt, and, if failure follows, the operation of laparotomy should be undertaken. In acute strangulation if relief is not speedily found, sloughing of the invaginated bowel may take place, and in the chronic, adhesion of the invaginated bowel; under either circumstance operative interference must fail. Of chronic.

Operative interference. Operative interference in intussusception, however, has not hitherto been very successful, and its failure, I believe, is owing to its having always been postponed to too late a period. Yet recent experience has been more encouraging, even under not very favorable circumstances, for Hutchinson has recorded a case ('Med.-Chir. Trans.,' vol. lvii, 1874) in which he opened the abdomen of a child æt. 2 on the thirtieth day of the symptoms, and drew out the invaginated bowel with a successful issue. Mr. Howard Marsh had a second case, in which a like good result was obtained in a male infant seven months old after symptoms of fourteen days' duration; while my colleague, Mr. Howse, had a third, in a woman æt. 23, a patient of Dr. Fagge's (ibid., vol. lix, 1876) in which recovery took place. I have likewise performed the same operation in a dog, pulling out on the fifteenth day, with a good result, six feet of invaginated bowel.

Dr. H. B. Sands, of New York, has also published another successful case in a child 6 months old ('New York Med. Journ.,' June,

Inflation.

1877)—the operation having been performed eighteen hours after the appearance of the symptoms. In intussusception, however, some success has followed, at times, the practice of inflation, a plan of treatment that was originally recommended by Gorham years ago, and which may be effectually carried out by connecting a syphon bottle of soda or other aërated water with a tube passed well into the bowel, the elastic gas forcing its way far better than water. When inflation cannot be used injections may be substituted. This operation, has, however, its dangers, as bowels have been ruptured by its use. I cannot therefore recommend it.

Inversion.

Inversion of the body has likewise been advised, with the chance, that the weight of the contents of the bowel above the involuted or obstructed segment may suffice to disengage it. Mechanical kneading of the abdomen, and the administration of an anæsthetic have also been employed with a similar object.

Opium.

Opium should always be given in all cases of mechanical obstruction, the drug not only relieving pain, but checking the peristaltic action of the bowel which is so injurious.

These remedies, however, are uncertain at the best, and should be tried in early cases, when the diagnosis is uncertain and operative interference rejected, but they must not be used when more active treatment is called for unless such treatment is absolutely forbidden.

Laparotomy,

Laparotomy "an operation of search."

from λαπαρα, the soft parts of the body below the ribs, and τεμνω, I cut, is a name which has been given by Dr. John Ashurst, jun. ('American Journ. of Med. Science,' 1874), to an exploratory operation upon the abdomen for the relief of an internal strangulation or intussusception, and is so good that I adopt it. The term "gastrotomy" is applied to operations upon the stomach for the removal of foreign bodies, "gastrostomy" to an operation upon the stomach with a view of establishing a permanent fistula, "colotomy" to those upon the large intestine, and "enterotomy" to those upon the small.

In laparotomy the abdomen should be opened in the median line below the umbilicus, though if an old hernia exists, the sac should be explored, and the abdominal incision made upwards from its neck. The abdomen should at first be explored by the finger, and more particularly towards the umbilicus, since it seems that bands are more often found opposite the promontory of the sacrum than anywhere else. If the finger fail to find out the band, the opening must be enlarged and the parts inspected. When the operation is performed for intussusception, and the bowel is exposed, difficulty has been experienced in freeing the involved bowel, and, under such circumstances, the expedient used by Mr. Hutchinson should be employed and the invaginated portion pushed out backward from its sheath. The wound should be carefully adjusted by stitches. After the operation, the patient should be kept under the influence of opium or morphia—the morphia suppository every five hours being the best form to use. Milk diet should be given in small quantities, and, if recovery is to follow, it will probably be speedy; as repair takes place rapidly in all abdominal sections when a case goes on well, and death ensues early when the reverse occurs.

Enterotomy.

Enterotomy,

or the opening of some portion of the small bowel generally in the right groin, is an operation of great value, and it is to be regretted that it has not received sufficient notice. It was first performed by Nélaton,

at least twenty-five years ago, upon a patient of Trousseau's, for chronic intestinal obstruction, and is applicable to cases of abdominal obstruction in which the clinical evidence points to the conclusion that the obstruction is high up in the large intestine or low down in the small; to cases in which "laparotomy" is inapplicable and "lumbar colotomy" is out of court—to cases of obstruction in which relief is required and a more exact method of giving it is not clear, either from some difficulty in diagnosis or other cause. It is described by Trousseau as follows ('Clin. Med.,' lecture 77):—"I begin the operation, as Nélaton advises, by making in the right side an incision an inch in length, a little above the crest of the ilium, parallel with Poupart's ligament (Fig. 258); the length of this incision is subsequently increased to three or four inches. In dividing, layer by layer, the skin, the cellular tissue, the muscles, and aponeuroses, tying as may be required the large vessels involved in the incision, we at last come to

The operation.

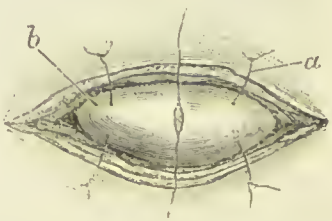
Fig. 258



Inguinal wound made in Nélaton's 'Operation of Enterotomy.'

the most deeply-seated aponeurosis. Proceeding always very slowly, and being very particular in sponging the wound carefully, this deep aponeurosis is cut through, when forthwith the peritoneum is reached. It is taken hold of by a small forceps and incised; afterwards using the greatest possible precautions, a silver thread, by means of a curved needle is carried, first through the intestine and then through the abdominal walls; four sutures are then made, two on each side of the incision; two others are made, one at the superior and the other at the inferior angle of the wound; but this time the abdominal parietes are first perforated, then the intestine, and afterwards the abdominal parietes on the opposite side of the wound (*vide* Fig. 258A). In this way the intestine is fixed everywhere, laterally and from above down-

Fig. 258A.



Mode of securing bowel before opening it.

wards, to the walls of the abdomen; by this proceeding no exudation can take place into the peritoneum. *It is then only necessary to make an exceedingly small incision in the intestine* by means of a sharp-pointed bistoury. The opening which Nélaton makes is less than a third of an inch."

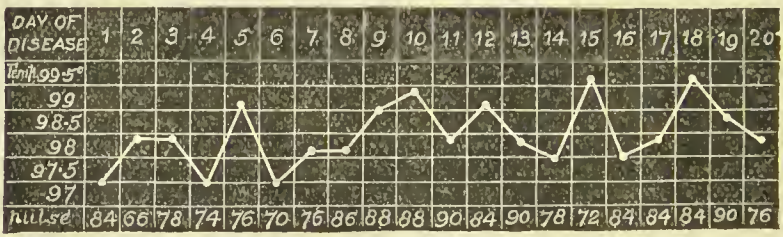
This operation is very warmly advocated by Trousseau in all cases of intestinal occlusion from whatever cause, "when the symptoms of occlusion have existed for six or eight days, when there is great tympanitis, when the matters vomited are of a stercoraceous character, and, finally, when the persistence and severity of the symptoms presage imminent death." He had recommended its adoption in five cases, and in two with complete success, the patients recovering, who, without it, would have been hopelessly lost.

In recent times this operation has been successfully performed by Mr. McCarthy on the suggestion of Mr. Maunder in 1872 ('Med.-Chir. Trans.,' vol. lv), by Mr. Wagstaffe ('St. Thomas's Hosp. Rep.,' 1873), by Mr. Maunder himself in November, 1875 ('Trans. Clin. Soc.,' vol. ix, 1876), and by others.

Cases.

I have performed it three times, once in 1876 on an infant twelve days old, who was born with an imperforate rectum, and survived the operation eight days, having been greatly relieved by it, but operation had been postponed until too late. The second was in May, 1877, on a man æt. 57, who had been a patient of Dr. Wilks, for chronic small intestinal obstruction of many months' standing, the chronic condition being aggravated every week or ten days by symptoms of a severe character, which threatened life. The seat of the obstruction was too uncertain to allow of the operation of colotomy being performed; indeed the symptoms pointed to the small bowel as being the seat of the disease, and on that account enterotomy was undertaken. The operation gave rapid and permanent relief and the man was convalescent in a month. His temperature, as shown by the chart, was never higher than 100°. He is alive and well at the present day; but the inconvenience connected with the artificial anus is so troublesome as to neutralise greatly the advantages of the operation. The third

FIG. 259.



Thermograph of case of enterotomy, in a man, æt. 57, for chronic obstruction. Temperature never reached 100°, and patient was convalescent in a month. Fluctuation of temperature very slight.

was on the person of a man, æt. 50, whom I saw in consultation with Dr. Cortis, of Kennington, in July, 1877, for complete intestinal obstruction. He had been ill two months with abdominal pain and constipation, but sought advice only when the pain had become very severe

and vomiting appeared. When I saw him, the constipation was insuperable, vomiting incessant, and the abdomen much distended. No obstruction could be felt in the rectum; both loins were very resonant, and it was believed that the obstruction was about the cæcum. I consequently performed Nélaton's operation of enterotomy as described, on July 7th. The operation gave immediate relief, and everything went on well subsequently, the temperature never rising beyond 99°. He left the hospital six weeks afterwards, the whole of his motions passing through the artificial anus, and not a trace of wind or motion passing per anum.

On his return home, for want of good nursing, a bed sore appeared, and he died in November, 1877. After death it was found, that the lower part of the ileum had been opened three inches from the cæcum, and that the seat of stricture was in the ascending colon just above the cæcum. It was cicatricial, and evidently due to the contraction of some old ulcer; the viscera were healthy. I subsequently learnt from Dr. Cortis that this patient had hurt himself in the right side of his abdomen three years before his illness in a fall over a case of goods, that the accident was followed by sickness and pain, with nausea and occasional vomiting. It is quite possible that the stricture was the result of this injury.

This patient, as well as the other, complained sadly of the annoyance caused by the constant flow of fæces from the inguinal anus, no mechanical appliance having the power of controlling it.

Colotomy.

On the operation of colotomy.

For irremediable stricture or mechanical obstruction of the rectum from any cause, *Callisen's* operation of opening the colon in the *left* loin should always be followed; but, when the seat of obstruction is higher than the rectum and if there be a doubt whether it is in the sigmoid flexure or transverse colon *Amussat's* operation in the right loin should be performed. Callisen first suggested colotomy in 1796, and applied it to the descending colon, but Amussat revived the operation and extended it to the ascending colon in 1839.

The colon in this position lies behind the peritoneum immediately beneath the transversalis fascia. The kidney is in close contact with it above, and in one case on which I operated, the organ was placed so low down as to fill in the space between the rib and pelvis, and had to be pushed upwards to allow the colon to be seen and opened. The operation can be performed as follows, on the left loin:

Mode of performance.

The patient is to be placed on his right side with a pillow beneath the loin, in order to arch somewhat the left flank, and turned two thirds over on his face; the outer border of the quadratus lumborum muscle can then be made out, as this muscle is the surgeon's main guide. Its outer border with the descending colon is to be found half an inch posterior to the centre of the crest of the ileum, the centre being the point midway between the anterior superior and posterior superior spinous processes. Allingham says that in more than fifty dissections he has always found the descending colon to be so situated. He has never known this point to fail him. When difficulties are felt in the operation, he believes they arise from the colon being looked for too far from the spine ('St. Thomas's Hosp. Reports,' 1870), and in that opinion I cordially agree. An incision is then to be made four or five

inches long, beginning an inch and a half to the left of the spine below the last rib, and passing downwards and forwards parallel with the crest of the ilcum; the line of the incision should pass obliquely across the external border of the quadratus lumborum muscle about its centre, so as to take the same direction as the nerves which traverse this part. By this incision, the integuments and muscles and fascia are divided, and the outer border of the quadratus muscle exposed. The abdominal muscles can be divided to give room, and this had better be done upon a director. All vessels are now to be secured. The transversalis fascia will next come into view, and beneath this will be the colon, a layer of fat sometimes interveuing. The fascia is to be opened with caution, for in the loose fat and cellular tissue the colon is to be found; when distended, the bowel comes at once under the eye on dividing the fascia, but when empty, some little trouble may be experieneed in hooking it up with the finger. It can always be found in front of the lower border of the kidney. This organ should consequently be sought, as it is the only certain guide to the bowel. I have found, however, on several occasions at this stage of the proceeding, great help by rolling the patient over on to his back, the bowel falling by this manœuvre on the finger, and being then readily caught.

When colon is empty.

Care in not wounding the peritoneum.

When the bowel has been caught, it should be partially rolled forward, in order to expose its posterior surface, for if this be not done there is a risk of the surgeon wounding the peritoneum where it is reflected from its anterior surface on to the abdominal wall. The bowel having been drawn up to the wound is then to be secured to the integument and not to the muscles, by the passage of a ligature introduced through one margin of the wound, then through the bowel, and lastly through the other margin. The bowel can then be opened by a longitudinal incision about three quarters of an inch long over the ligature that has traversed its canal; the centre of the ligature is then to be drawn out and divided, the two halves of the ligature fixing the two sides of the divided intestine firmly to the margins of the wound; and two or four more stitches may then be introduced to make the artificial anus secure. The margins of the wound may be oiled to guard against the irritation of fæces, and the patient placed in bed. At times, the fæces escape in large quantities directly the bowel is opened; at others some slight fæculent discharge will take place at the time, the larger flow taking place later. This is not, however, a matter of any importance, and the surgeon should take no measures to cause the bowels to act; indeed, it is better, as far as the operation is concerned, that the flow be postponed, for within an hour or so, the parts about the wound become sealed with lymph, and thus the risks of extravasation are diminished.

Passage of ligatures.

Opening of gut.

Mode of fixing gut.

Amussat originally suggested the *transverse* incision in the loins, and Callisen the *vertical*, the former crossing at right angles the outer border of the quadratus lumborum muscle, the latter running parallel with it. The *oblique* appears to me to be preferable to either, as it gives more room for manipulation when the colon is empty, it takes the line of the nerves and vessels that traverse this part, and lessens the risk of their division; it follows the ordinary integumental fold of a patient when assuming the recumbent posture, and thus favours repair, and seems to tend much towards the prevention of the prolapse of the bowel that is always liable to follow such an operation.

Variations in the operation.

Fig. 260 illustrates the line of incision and the appearance of the artificial anus. It was taken from a patient of Sir W. Gull's, æt. 64 that I operated upon in 1869 for vesico-intestinal fistula, and who died five and a half years subsequently (1875) from a ruptured heart. The gentleman followed his avocation without any discomfort.

After-treatment.

After the operation a good sedative should be given, such as opium, morphia, or chloral, and the recumbent position maintained, a piece of oiled lint covered with oakum, and kept in place with a soft towel, being the best application.

Sutures removed on fourth day.

The sutures may be removed on the fourth or fifth day, according to circumstances, while perfect cleanliness must be observed.

Nutritive food and stimulants may be given within a day or so of the operation, repair, as a rule, going on favourably.

Fig. 260.



Artificial anus after colotomy with the oblique incision.

Appliances after cicatrization.

When the wound has cicatrized, the patient may get up, and a pad covered by a folded napkin and fastened on with a lumbar binder, is the best application. The ivory ball or plug that has been recommended, appears to be a useless instrument, and cannot be kept in its place, nor does it prevent the prolapse of the bowel that is said to be so likely to follow the operation.

Value of the oblique incision.

With the oblique incision this prolapse does not appear to be the cause of any annoyance, since it seems to take place to a very slight extent.

When contraction of the orifice takes place to too great an extent, a sponge tent or short bougie may daily be introduced. I have, however, met with but one case requiring this treatment.

Cleansing of the lower bowel.

After convalescence, it is well to wash out occasionally the lower portion of the bowel with warm water, as some fæces are apt to pass the artificial opening and rest in the rectum, causing irritation. When the anal end is open, it is best to do this through the natural opening, and when closed, through the artificial.

Prognosis.

I have now performed this operation thirty-six times: in four

for vesico-intestinal fistula, in two for pelvic tumour, in one for fibrous growths in the rectum, and in twenty-nine for stricture of the rectum. One of the cases of vesico-intestinal fistula lived for four months after the operation, and died with suppurating kidneys entirely relieved from all vesical and rectal distress. ('Brit. and For. Rev.,' Jan., 1869.) One lived nearly six years after the operation, and died, æt. 70, from rupture of the heart. The third is now alive, six years after the operation, and enjoying life, suffering indeed very little inconvenience from the artificial anus. ('Clin. Soc.,' 1872.) The patient with pelvic tumour, already noticed, died on the third day from rupture of the tumour. The second was kept alive two months, and died from the disease. The one with fibrous growths in the rectum was operated upon Nov. 14th, 1877, and is now living in comfort.

Statistics of the operation.

Of the twenty-nine patients with stricture, cancerous and otherwise, one lived three years after the operation, and one eighteen months, dying from supposed cancer of the liver after a month's illness; two lived ten and three for five months, eight survived the operation from seven to eighteen days, eight died within a week, the operation in the majority of these cases having been undertaken as a last resource. Six were alive when last heard of, two having been operated upon three years previously, two two years, and two within the year. In every case marked relief was afforded to symptoms, and in many, the patients' expressions of gratitude for such were very strong, several having deeply regretted that the operation had not been performed at an earlier period.

In no single case have I ever regretted performing this operation, although in a large number I have wished earnestly that I had had an opportunity of performing it earlier, since in no instance where it was undertaken did it fail to give relief.

In one of the patients colotomized for vesico-intestinal fistula, who is now alive, six years after the operation, urine finds its way, when he is recumbent, out of the lumbar artificial anus, and, in the second case that survived the operation nearly six years, the same complication presented itself. In neither instance, however, was the flow a source of trouble. This flow, however, might have been enough to keep patent that portion of the intestine that existed between the artificial anus and the bladder, and to preserve it from atrophy; such a result of colotomy being clearly possible, Dr. Michael Harris, of Liverpool, having recorded in the 'Liverpool Hospital Reports' for 1874 the particulars of a post-mortem examination where Mr. Hakes had performed colotomy five years previously for vesico-intestinal fistula, in which the descending colon from the artificial anus, together with the sigmoid flexure and rectum as far as the bladder, had become *completely obliterated* and was found to be replaced by a cylindrical mass of fat. The length of this fatty column was about six or seven inches, and in the centre of it was found a fibrous cord of about a line in thickness, but no trace of a canal of any kind could be therein detected.

Curling has performed or recommended the operation in twenty-one cases, and in fourteen the patients survived over periods varying from two to eighteen months. Pollock gives a case where the patient had survived the operation for two and half years. Allingham has had ten cases: one died within a fortnight of the operation, five lived a

few months, one nineteen months, one four and a half years. Two were known to be living for three and four years after the operation.

These results cannot be regarded otherwise than with satisfaction, for it should be remembered that in all these cases the operation was undertaken when life was threatened, and the distress from the local disease was severe and otherwise irremediable. The operation is beneficial in all cases of vesico-intestinal fistula when solid fæces flow with the urine; in all cases of stricture of the rectum so soon as the obstruction becomes serious and local distress great; in all other cases of mechanical obstruction to the rectum from pelvic causes, when no less severe measures for relief can be suggested; and, last, but not least, in extensive ulceration of the rectum, cancerous, syphilitic, or simple, when local treatment fails to give relief, and local distress is great, when the general powers are evidently giving way from the local disease quite irrespective of all mechanical obstruction. Operation when advisable.

In no case, however, should the operation be postponed till the patient's powers are failing, for then the prospects of recovery are greatly lessened and convalescence is often rendered improbable.

By way of summary, therefore, it may be stated that— Summary.

Laparotomy is an operation which should be performed in all cases of acute intestinal obstruction due to bands, internal hernia, and intussusceptiou, that do not speedily yield to other treatment.

Colotomy is applicable to cases of obstruction to the large intestine from stricture or the mechanical pressure of tumours.

Enterotomy affords a means of relief for all other cases of intestinal obstruction to which the two former operations are inapplicable.

On Tapping the Intestine.

On tapping the intestine.

The practice of tapping the intestine with a fine trocar and cannula in cases of intestinal obstruction, is one which deserves serious consideration, since there is good reason to believe, that a small puncture may often be made into a distended intestine and wind drawn off without any extravasation of the contents of the bowel taking place; and that if the distension of the strangulated, twisted, or otherwise obstructed bowel can be relieved by the operation, there is some ground for hope that natural efforts may then release the bowel from beneath its band or from some internal peritoneal ring, and that even a twisted bowel may untwist. The operation, however, is not without its risk, as I have on several occasions known fæcal extravasation to follow the practice, and Coupland and Morris quote other cases. I have been also led to believe that even in a large hernia, its strangulation might be relieved by a like operation and a natural reductiou take place; for a strangulated bowel, outside as well as inside the abdominal cavity, is strangulated by the distension of the intestine itself, more than from any extra-intestinal influence, and if this distension can be relieved by simply drawing off the contents of the bowel by means of a very fine trocar and canula, the walls of the intestine would collapse, strangulation cease, and unless adhesions confined the bowel in its position, its return might be looked for by natural efforts. These remarks are based upon the fact, that intestine may be so treated without any extravasation following, and such actually came before me in a case of ileo-colic scrotal hernia, in a gentleman æt. 76, when, to enable me to reduce the bowel, I was driven to puncture the protruding intestine in four or Arguments in favour. Case in which it was performed.

five places, and although much manipulation followed this practice, no extravasation occurred at the time or after, and a rapid recovery ensued without a drop of suppuration. The case occurred in the practice of Mr. Kelson Wright, of Kennington. These remarks are only to be read as suggestions, and more particularly as applied to large umbilical and scrotal herniæ. Since the introduction of the pneumatic aspirator by Dr. Dieulafoy this practice has received much encouragement. For more detailed evidence on the subject of intestinal obstruction and its treatment, the following papers may be referred to:

Brinton, 'Croonian Lectures,' 1859.—Fagge, 'Guy's Reports,' 1868.—Gay, 'Trans. Lond. Med. Soc.,' 1861-2.—Gorham, 'Guy's Reports,' vol. iii, series 1.—Hinton, 'Association Med. Journal,' 1853.—Smith, 'American Journal of Med. Science,' 1862.—Bryant, 'Med. Times,' 1872.—'A Treatise on the Pneumatic Aspiration of Morbid Fluids,' by Dr. George Dieulafoy, 1873.—Trousseau's 'Clinical Medicine.'—Hutchinson, 'Med. Chir. Trans.,' vol. lvii, 1874.—Coupland and Morris, 'Brit. Med. Journ.,' Jan. 26, 1878.—Bryant, 'Lancet,' May, 1878.—'Clinical Society,' 1878.

On Tapping the Abdomen.

Paracentesis of abdomen.

Whenever fluid collects in the abdominal cavity so as to interfere with life's functions, the operation of tapping may be called for. It may be for *ascites*, a collection of fluid in the peritoneal cavity; for *ovarian dropsy*, a collection of fluid in a single or in a polycystic tumour; or for *hydatid*, whether hepatic, pelvic, or peritoneal. It may also be called for in *renal* or *splenic* cysts.

It would be out of my province to enter minutely into the diagnosis of all these conditions, as the majority of such cases come under the care of the physician, the surgeon being called in simply to operate. Nevertheless, it may be as well to give some of the leading points of diagnosis, for I need scarcely say that the operating surgeon is not relieved of all responsibility of diagnosis by the fact that a medical mind has charge of the case. The operator, as such, assumes part, at least, of the responsibility of the case as well as of the operation.

Diagnosis previous to tapping.

Ascites.

Diagnosis.—In a general way it may be asserted, therefore, that *ascites* is the result of a chronic action that has been going on for some time, arising from liver, peritoneal, heart, or renal disease, the abdominal dropsy being one of the results only. The history of the case consequently will be a great help in arriving at a conclusion. The fluid, moreover, will be found to fill the abdominal cavity equally; fluctuation being perceptible across the abdomen, and from before backwards well into the loins, even when the abdomen is resonant. As a rule, the intestines will be found floating upwards, thus giving resonance on percussion, the position of the bowels being influenced by that of the patient. With the body horizontal, they will give resonance at the umbilicus; with the pelvis depressed, above this point; with the pelvis well raised, resonance may even be detected near the pubes. In almost all these cases the sound over the loins will be dull. On looking at the abdomen the surface will be smooth and the enlargement equal. The subject of diagnosis of ovarian and uterine disease will receive attention in Chapter XXVII.

The operation.

Description of the operation of tapping.

The instruments required for the operation are a moderate-sized trocar and canula; an india-rubber tube about six feet long adapted to a silver-tubular plug that fits the canula when the trocar is removed; a lancet or small scalpel; a pad of lint; and a roll of good strapping.

Some surgeons prefer one of the modern instruments by which the

india-rubber tube is attached to the canula at right angles, and they are very good; but those I have named are ample.

Position of patient.

The patient should be brought to the edge of the bed and placed in the recumbent position, with the shoulders raised; a folded sheet or piece of mackintosh cloth having been previously so arranged as to protect the sheets. A catheter should first be passed, then with the trocar and canula warmed and oiled, and a pail at hand, into which the end of the india-rubber tube is allowed to hang, the surgeon may with a lancet make a small incision through the skin and soft parts, about three inches below the umbilicus, or at any other spot at which the operation is to be performed. He should next introduce the trocar and canula with a direct force and semi-rotatory movement of the wrist, guarding, with his forefinger fixed about one inch from the end of the canula, against inserting the trocar too far. The abdomen having been punctured, the trocar may be removed with the right hand, the canula being pushed further in at the same moment with the thumb, and its orifice plugged at once with the left thumb, to prevent the escape of fluid. The silver plug of the india-rubber tube may then be introduced and the fluid allowed to escape, the distal end of the tube being kept submerged in the fluid in the receptacle; the tube acting as a syphon.

Details of operation.

To facilitate the flow and to evacuate the whole contents of the cavity, some surgeons roll the patient over on the side, or place him so at the first; but such a proceeding is unnecessary.

Mode of finishing the operation.

When the fluid has ceased to flow, the canula is to be gently removed, the thumb and finger of the left hand nipping up the soft parts as its end appears, so as to prevent the admission of air into the abdominal cavity, and the trickling of any fluid down the patient. The edges of the wound may then be adapted by a piece of good strapping, and a pad of lint applied when oozing appears, but not otherwise; two or three bands of strapping, three inches wide, should then be adjusted to the front of the abdomen from side to side. Where great hollowness is left, a pad of cotton wool often gives comfort. The old-fashioned flannel bandage may be abolished, as it is only an inconvenience.

All pressure on the abdomen during the flow of the fluid should be avoided as unnecessary, and also all pressure after the operation; support only being required.

Site of the operation.

The usual place to perform the operation is in the linea alba, about two or three inches below the umbilicus; but in ovarian disease any point in the linea semilunaris may be opened, and in rare cases any other.

Use of aspirator.

When a hydatid, renal or splenic cyst requires to be tapped a small trocar and canula, such as is employed for tapping a hydrocele, should be used; though in these cases, the Pneumatic Aspirator is of great service, for by its use the fluid can be removed without the possibility of air being introduced.

Hydatid tumours

Hydatid abdominal tumours.

of the liver, spleen, or other parts of the abdomen are occasionally met with, and, however large a size they attain they rarely produce other symptoms than those mechanically caused by their size, and on that account they may require treatment. Their origin is indicated by their position, although when situated in the pelvis, there may be an impossibility in diagnosing them from ovarian cysts. They are almost always very globular and tense, and rarely give rise to distinct

Diagnosis of hydatid tumours.

fluctuation. The external feel of a hydatid is somewhat peculiar and characteristic. In 1868, I removed with permanent success, an enormous hydatid tumour from the abdomen, although apparently not from its cavity, of a lady patient of Dr. Oldham, æt. 35, who was believed to have had ovarian disease ('Guy's Hosp. Rep.,' 1868), while Mr. Spencer Wells records a case in which the hydatids were turned out of the abdominal cavity. Sometimes the hydatid dies without surgical interference, and, as a consequence, severe suppuration is set up with violent constitutional disturbance, which requires surgical aid.

Treatment when suppurating.

Not long since I opened, with marked success, a large abscess over the liver of a boy æt. 17, and evacuated a quantity of pus, bearing the peculiar odour of hydatid pus. The abscess clearly came from the liver, and was a suppurating hydatid. The boy previously had suffered from tape worms. In 1869, I had to open freely a suppurating hydatid tumour, which half filled the abdomen of a gentleman, æt. 40, who had had it tapped some months before in Australia, and a complete recovery ensued. A quantity of dead hydatid cysts escaped through a large cannla that was introduced. The cyst was washed out daily with great benefit. This gentleman is now quite well. I have had at least six other cases in which a like treatment was employed with success, nor have I lost one, although several have had a very narrow escape. The secret of the treatment of suppurating hydatid cysts consists in a free outlet for all purulent and dead hydatid deposits, and the frequent washing out of the suppurating cavity with water containing iodine, Condy's fluid, carbolic acid, or creosote, with or without the introduction of a drainage tube or elastic catheter. For the operation, a large trocar and canula should be employed—the canula being left in for some days until a good opening is established; it may then be exchanged for an elastic catheter or large drainage tube.

Before suppuration.

Before suppuration takes place, however, other treatment is applicable, such as draining off partially or wholly the fluid contents of the hydatid by means of a very fine trocar and canula. I have performed this operation on many occasions with success, but generally prefer to draw off only a few ounces of the fluid; clinical experience indicating that by this measure alone the hydatid may be killed, subsequently withering up and ceasing to hurt. Dr. J. Miller, of Tasmania, where this disease is frequent, speaks highly of the use of twenty-grain doses of the bromide of potassium three times a day after the tapping, and Dr. Bird, of Melbourne, combines with it drachm doses of the tincture of kamela. At times, also, cases which have been looked upon as cured are not so, and, after the lapse of years the disease re-appears. When suppuration follows tapping, however, a cure ensues.

Case of sudden death after tapping.

The operation of simply tapping a hydatid with even the finest instruments is not, however, free from danger, for in January, 1877, I tapped a man æt. 42, who, with the exception of the hydatid tumour of the liver, was in perfect health, and drew off half a pint of hydatid fluid, having to perforate the structure of the liver to the depth of an inch to reach the cyst. The operation was not attended by the slightest distress; but on the removal of the needle an agonizing pain attacked the man's face and jaws, accompanied with flushing of the head and neck. This was followed by vomiting, extreme pallor, and stertorous breathing for a minute, followed by death in two minutes. At the necropsy nothing

was found to account for this sudden end, that is, there was no embolism or heart trouble, no brain disease, nothing but a large hydatid cyst behind the liver. The needle had, however, passed through a misplaced portal vein on its way to the hydatid, and the question arose as to the possibility of death being due to the mixing of the hydatid fluid with the venous blood. No blood was extravasated (Clin. Society, 1878). My colleagues, Dr. Fagge and Mr. Durham, have given us some evidence that a cure can be obtained by electrolytic treatment, on Dr. Althaus's plan of introducing into the tumour two electrolytic needles, one or two inches apart, connected by means of wire to the negative pole of a galvanic battery of ten cells, and completing the current through the tumour by means of a moistened sponge, attached to the positive pole of the battery, applied for ten or more minutes at a time to different points over the swelling. ('Med.-Chir. Trans.,' vol. liv.) This operation may be repeated according to circumstances. Electrolysis.

Such treatment may be employed when simple tapping fails to cure. Some of the patients reported as cured by these means have returned, however, with the disease, and it is still a question whether more is gained by this method than by simple puncture and the withdrawal of some of the hydatid fluid.

Further information may be gained from Murchison's work on the liver, 1868, Harley's paper, 'Med.-Chir. Trans.,' vol. xlix., and Dr. Bird, of Melbourne's, book.

Tumours of the Umbilicus.

Pedunculated outgrowths from the umbilicus are not uncommon and always found in children, being composed of simple granulation tissue; indeed, it seems probable that they are really due to excess of granulation growth from the point at which the umbilical cord separated. They sometimes attain a large size, and have occasionally a slight central canal or orifice, though the former never travels far. I have seen one the size of the last joint of my little finger. They are easily cured by the application of a ligature to their bases. Pedunculated umbilical growths.

These tumours, however, must not be confounded with a condition that is occasionally met with, viz. the presence of a fleshy outgrowth not unlike a glans penis, through which a real canal extends into the bladder, the canal being clearly an open urachus. I have seen only one such case, and recorded it in my Lettsomian lectures on the surgical diseases of children, 1863. I wished to cauterise the surface of the canal and thus cause its contraction and closure, but was not allowed. Patent urachus.

I have also seen a large hernial protrusion appear at the umbilicus, with the whole surface ulcerated, in which there were some solid contents which I took to be the liver. It subsequently completely cicatrised and a good recovery ensued. The drawing of this case is in Guy's Hospital Museum (*vide* fig. 284). Ulcerated hernial protrusion.

Sebaceous tumours, as well as accumulations of sebaceous matter are also met with at the umbilicus in dirty people. I have turned out large masses of such indurated secretion from the cup-like depression. Sebaceous deposits.

Cancerous tumours, &c., as well as simple warty growths and syphilitic condylomata, may also exist in the same position. Cancerous, warty, and syphilitic tumours.

CHAPTER XV.

HERNIA.

Diagrams illustrating the different forms of Hernia, with some of its complications.

In all these diagrams the thick black line represents the parietes covering in the hernial sac; the thin line the peritoneum and hernial sac; the small body at the bottom of the sac the testicle.

Fig. 261.



Fig. 261.—This diagram illustrates the tubular vaginal process of peritoneum open down to the testicle, into which a hernia may descend. When the descent occurs at birth the hernia is called "congenital;" when at a later period of life the "congenital form," Birkett's "hernia into the vaginal process of peritoneum," or Malgaigne's "hernia of infancy."

Fig. 262.



Fig. 262.—The same process of peritoneum open half way down the cord, into which a hernia may descend at birth or at a later period. Birkett's "hernia into the funicular portion of the vaginal process of the peritoneum."

Fig. 263.



Fig. 263.—The same process undergoing natural contraction above the testicle, explaining the hour-glass contraction met with in the congenital form of scrotal hernia as well as in hydrocele.

Fig. 264.



Fig. 264.—Diagram showing the formation of the "acquired congenital form of hernia," the "encysted of Sir A. Cooper," "the infantile of Hey," the acquired hernial sac being pushed into the open tunica vaginalis which encloses it.

FIG. 265.



FIG. 265.—Diagram illustrating the formation of the "acquired" hernial sac, distinct from the testicle or vaginal process of peritoneum which has closed.

FIG. 266.



FIG. 266.—Illustrates the neck of the hernial sac pushed back beneath the abdominal parietes with the strangulated bowel. (*Vide* fig. 279.)

Second variety of displaced hernia.

FIG. 267.



FIG. 267.—Shows the space in the subperitoneal connective tissue into which intestine may be pushed through a rupture in the neck of the hernial sac; the intestine being still strangulated by the neck. (*Vide* fig. 280.)

Third variety of displaced hernia.

FIG. 268



FIG. 268.—Diagram showing how the neck of the vaginal process may be so stretched into a sac placed between the tissues of the abdominal walls either upwards or downwards between the skin and muscles—muscles themselves or between the muscles and the internal abdominal fascia—forming the intra-parietal, intermuscular, or interstitial sac; hernia *en bissac* of the French; "additional sac" of Birkett. (*Vide* fig. 281.)

Fourth variety of displaced hernia.

FIG. 269.



FIG. 269.—Diagram illustrating the reduction of the sac of a femoral hernia *en masse* with the strangulated intestine.

First variety of displaced hernia.

ABDOMINAL HERNIA.

On hernia.

Abdominal hernia or rupture signifies the protrusion of any viscus through an opening in the parietes of the abdominal cavity. This

Situation.

protrusion for the most part occurs at the *inguinal* and *femoral* canals or *umbilicus*, though, occasionally, at other parts when the abdominal walls have been weakened by some inflammatory lesion, rupture, or division of muscle from injury or operation, and more rarely at such weak points of the abdominal walls as the obturator foramen, the perineum, the ischiatic notch, the diaphragm, or the vagina.

Class of society.

It is met with in subjects of every social condition, but most frequently amongst the so-called working classes; and, probably, as Mr. Kingdon informs us in his excellent paper on hernia ('Med.-Chir. Trans.,' 1864) because "hernia occurs oftenest in the most numerous classes, and not in the most laborious."

Hereditary tendency.

Hereditary predisposition to hernia is also doubtless a reality; a third of all cases acknowledging a history of having a ruptured parent; such predisposition probably existing as a general laxity of the mesenteric folds and parietal layer of peritoneum. I have been called upon to operate on an old gentleman, the male branches of whose family for four generations—twelve in all—have been ruptured. Inguinal hernia is often due to a failure in the natural closure of the sheath of peritoneum that travels down with the descending testicle, which failure is more common on the right side.

Subjects who are congenitally feeble, and others who become weak from illness or old age, are more liable to hernia than the robust, the weakness of the abdominal parietes yielding to the natural pressure of the abdominal contents under the influence of some sudden or prolonged muscular exertion. Although a large number of the cases of hernia are slow in their development, many are sudden, and in all, muscular exertion plays an important part.

Proportion as to its seat.

Out of every 100 cases of hernia, 84 are *inguinal*, 10 *femoral*, and 5 *umbilical*. It is more common in males than females, in the proportion of 4 to 1; 18,492 females only having been applicants for trusses at the Truss Society, out of the total of 96,886 ('Report,' 1871).

Hernia in females.

Females are as liable to inguinal hernia as they are to femoral, the inguinal being most common in early life from the canal of Nuck being open; the femoral in middle and old age. In females under 20 years of age there are 87 cases of inguinal hernia to 13 of femoral; and after 40 years there are 32 cases of inguinal to 68 of femoral. The largest number of cases of femoral hernia are developed during the child-bearing period of a woman's life, that is, between 20 and 40 years of age. Prior to menstruation it is so rare as to be almost unknown. Kingdon gives only four such cases.

Hernia in males.

In males, *inguinal* hernia is the usual form, Kingdon's table showing that the largest number of cases occur during the first ten years of life, in consequence of the vaginal process of peritoneum that covers the spermatic cord being still open. It is about half as frequent between the ages of 10 and 20 years, while between 20 and 40 it is as common as it is at the early period of life, but its frequency rapidly diminishes after that period.

Femoral hernia occurs in the male about 4 in every 100, though it becomes, as in the female, relatively more common than inguinal as age advances. During the first ten years of life it is not met with more frequently than 1 in 300; whilst between the ages of 10 and 20, 2 per cent. are femoral; between 21 and 40, 4½ per cent.; between 41 and 60, 6 per cent.; and above 60, nearly 8 per cent.

Average age when strangulated.

The average age of persons suffering from *strangulated inguinal* hernia is 43, but from femoral 55. A hernia that becomes strangulated in its first descent is far more acute and fatal than that which has been of long standing, and a femoral hernia is more liable to become so strangulated than an inguinal in the proportion of 3 to 1. These "recent cases" of femoral hernia mostly occur in old women about 60 years of age, and of inguinal in young men, the hernia being in the latter of the "congenital kind."

Anatomy of a hernia.

Anatomy of a Hernia.

A *hernial tumour*, with few exceptions, is composed of a *sac* with its *contents* and the soft parts covering it.

The *sac* is made up of peritoneum, is formed by the gradual stretching and pouching of this membrane through an opening in the abdominal parietes by the protruding viscera, and, being artificial, has been well named by Birkett the *acquired hernial sac*, this term distinguishing it from a second form—equally well named—the *congenital hernial sac*, which is only found in inguinal hernia, being composed of the vaginal tubular process of peritoneum formed by the descent of the testicle—the opening that normally exists in fœtal life not having closed owing to some deficiency in the obliterating process that naturally commences at the internal ring and proceeds downwards towards the testis in the scrotum.

Acquired hernial sac.

Congenital hernial sac.

The formation of the hernia in the former case is a gradual, but in the latter a rapid process, the "acquired" hernia being an affection of middle and old age, the "congenital form" one of infancy or young adult life.

The sac also is composed of a body and a neck, which communicates by a mouth with the abdominal cavity. When the hernia is small, the neck and body appear as a small pouch, into and out of which the hernial contents pass with facility; the sac having no narrow neck by which the return of the intestine can be retarded But when the hernial sac is large, and has escaped into looser tissues, its body or fundus so expands as to render by comparison the neck of the sac a narrow canal or orifice, the return of the hernial contents often becomes one of difficulty, and under these circumstances it frequently becomes strangulated.

Changes in the neck of hernial sac.

The neck of the sac also undergoes changes which it is essential to understand, particularly in cases of scrotal hernia, where the peritoneum is so forced outwards through the inguinal ring as to fall into puckered folds.

These folds will disappear, however, if the hernia and sac be reduced into the abdominal cavity or the constricting ring of tissue external to it be divided, the degree of unfolding of the neck of the sac being regulated by the amount of expansion of which it is capable. But should the sac be neither returned nor its constricting ring of outside tissue divided, the puckered folds of peritoneum will adhere,

and probably the subperitoneal connective tissue will unite with it; the neck of the sac, under these circumstances, becoming indurated and thickened, and in an old inguinal hernia having an independent existence, requiring special treatment in operation.

This thickening, moreover, as time progresses, is followed by contraction, and as a consequence a narrowing and rigidity of the neck of the sac, which necessitates in old inguinal hernia, when an operation for strangulation is required, the opening of the sac and a free division of its neck.

Absence of sac.

When a hernia forms at the seat of a wound in the abdominal wall there is no sac, and the same occurs when the cæcum or colon protrudes through the inguinal canal.

Contents of hernia.

The *contents* of a hernia are usually small intestine and omentum, a portion of the last two feet of ileum being, as a rule, involved; the cæcum and colon also are occasionally so, and cases are on record in which the bladder, stomach, or ovary has been found in the sac.

Omental sac.

At times the omentum is so pushed before the intestine as to cover it completely, thus forming an inner sac; the bowel, as a rule, being behind the omentum.

Varieties.

When intestine protrudes, the hernia is called an *enterocele;* when omentum, *epiplocele;* when both intestine and omentum occupy the sac, *entero-epiplocele;* when bladder, *cystocele;* when stomach, *gastrocele*, &c. &c.

Soft parts covering hernial sac.

The tissues that cover in a hernial sac will necessarily depend upon the seat of the hernia. Thus, in the *umbilical*, it may be only the membrane of the cord, skin, and abdominal fascia; in the *scrotal* it will be the scrotal tissues; in the *femoral*, the skin with the superficial and deep fasciæ; but in all, and more particularly in the femoral, the surgeon should bear in mind the anatomical fact, that a layer of fascia —which lines the abdominal muscles and separates them from the peritoneum—covers in the true peritoneal sac, and is known as the "fascia propria" of Sir A. Cooper, and between this fascia and sac some subperitoneal fat often exists.

Reducible, irreducible, and strangulated.

When a hernia comes down into a sac and goes up again, either by itself or aided by position or by the surgeon, it is called *reducible;* when it cannot be returned it is called *irreducible;* when it is constricted sufficiently to interfere with the return of the contents of the protruding viscera it is known as *incarcerated*, and when in addition the circulation of the part is interfered with, it is said to be *strangulated.*

When the protrusion takes place *above* Poupart's ligament, through the internal ring, but does not traverse the canal sufficiently far to

Bubonocele.

appear through the external, the hernia is called a *bubonocele* (*vide* right side of Fig. 270); when it protrudes through the external

Scrotal.

ring into the scrotum, a *scrotal hernia* (*vide* left side of Fig. 270), both forms being included in the term *oblique inguinal hernia.*

Direct inguinal.

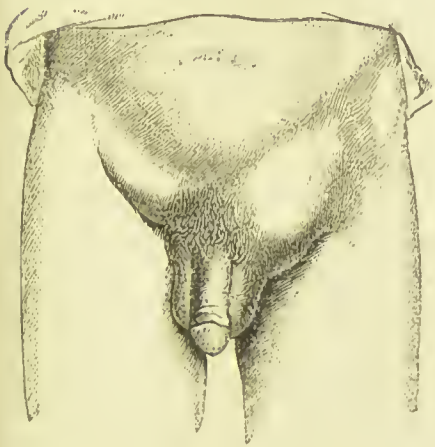
When a hernia makes its way directly through the external ring without having passed down the inguinal canal, it is called a *direct inguinal* (Fig. 271).

Femoral.

A *crural* or *femoral hernia* is *below* Poupart's ligament, the protrusion having come down through the crural ring on the inner side of the sheath of the femoral vessels (Fig. 272).

An *umbilical hernia* or exomphalos is a protrusion at the navel. A *ventral* is a protrusion at any other part of the abdomen. The names of every other form are according to the locality. Umbilical.

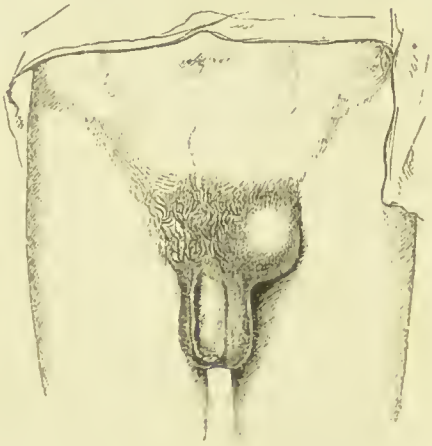
FIG. 270.



OBLIQUE INGUINAL HERNIA.

Bubonocele on right side, but passing through external ring on left.

FIG. 271.



DIRECT INGUINAL HERNIA.

Symptoms.—A hernia in its early stage may show itself as a mere *fulness* about the internal inguinal, the crural ring, or other opening; this fulness becoming very manifest on the patient standing and coughing. The patient's attention has probably been drawn to the part by a feeling of *weakness* on taking exertion, or, in performing any natural act demanding the strong action of the abdominal muscles. With this weakness there is often associated some griping abdominal pain or feeling of uneasiness—wrongly attributed to constipation—and in old people these symptoms should always attract the notice of the surgeon. Symptoms of hernia. Fulness at ring.

FIG. 272.



FEMORAL HERNIA.

Tumour.

As the hernial pouch increases the tumour in the inguinal canal, at the femoral ring or umbilicus, will show itself as a distinct swelling, this being manifest when the patient stands or coughs, but disappearing on his lying down. It will, moreover, be prevented from returning on the patient assuming the erect posture, by the finger being placed over the ring. The swelling also always comes from above and travels downward. As the tumour still further increases a distinct Impulse on coughing.

Gurgling.

impulse will be felt by the hand when placed over it if the patient coughs, and a peculiar gurgling sound will be heard on the application of pressure to the part to cause its reduction. The return of the bowel also into the abdominal cavity will be marked by the disappearance with a jerk of the contents of the sac, and a distinct appreciation by the finger of the aperture through which it has passed.

Capable of being replaced.

Diagnosis of contents.

"If the surface of the tumour be uniform, if it be elastic to the touch, if it become tense and enlarged when the patient is troubled with wind, holds his breath or coughs; if in the latter case it feels as if it were inflated, if the part return with a peculiar noise and pass through the opening at once, the contents of the swelling are *intestine*. If the tumour be compressible, if it feel flabby and uneven on the surface, if it be free from tension under the circumstances just enumerated, if it return without a noise and pass up gradually, the case may be considered an *epiplocele*. If a portion of the contents slip up quickly and with noise, leaving behind something which is less easily reduced, the case is probably an *entero-epiplocele*." (Lawrence.)

Hernia of infants.

In infants where Malgaigne's "hernia of infants" exists (Fig. 261), or Haller's "hernia congenita," both being caused by the descent of intestine into the open vaginal process of the peritoneum, the tumour is very often large when first discovered and often scrotal. In young adults, where the same kind of hernia exists, the swelling comes suddenly and at once, by one rush downwards into the scrotum, this rush being accompanied with pain.

Treatment.

In all these forms of hernia, when reducible, either the *palliative* plan of treatment may be employed, or what is known by the *radical cure*.

Palliative use of truss.

The palliative treatment consists in the application of a *truss*—an instrument composed of a pad or cushion, connected with a metallic spring or with straps, and so arranged that the pressure of the pad keeps the hernia from descending; the spring maintains the pad in position, and at the same time allows perfect freedom of movement of the body. Any truss that accomplishes this is beneficial, but any that fails in this is worse than useless, as it is injurious, and gives false confidence.

The operation for the *radical cure* of hernia will be considered under the heading "Inguinal hernia."

Hydrocele of hernial sac.

Hydrocele of the Hernial Sac

is a very rare affection, and not more than six cases are on record. I have seen but one true example of it, that is, if the term be confined to such cases of accumulation of fluid in the hernial sac in which the neck of the sac is occluded by some adherent omentum or intestine, or by the radical cure. The case occurred in a man æt. 40, who had been treated for hydrocele of the right testicle for twenty years, and had frequently been tapped. He was under my care with a scrotal swelling which extended up to the internal ring, and obscure symptoms of intestinal obstruction. He was tapped and serous fluid was drawn off, but the symptoms continued. After the lapse of two or three days, as the abdominal symptoms increased in severity in my absence, an exploratory operation was performed, and a mass of what was supposed to be omentum or an omental sac containing intestine was found blocking up the internal ring. This was opened and

Case.

the mucous membrane of the bowel exposed. The opening into the bowel was stitched up, but the symptoms persisted, and the man died two days later of peritonitis. An examiuation after death showed, that what had been regarded as an hydrocele was a dropsy of the congenital form of heruial sac, and what had been opened as a mass of omentum or omental sac was a knuckle of ileum matted together and to the neck of the sac by lymph—this adhesion giving rise to the fatal obstruction. No hydrocele existed. Such cases as these should not be mistaken for dropsy or suppuration of the hernial sac after herniotomy, which are by no means unfrequent conditions and should be treated by tapping, or, a free incision.

Dropsy of sac after herniotomy.

Irreducible Hernia.

When the contents of a heruial tumour cannot be returned into the abdominal cavity an irreducible hernia is said to exist, aud this condition may be brought about by anything that alters the relations between the bulk of the tumour and the neck of the sac or opening through which they would have to return, such as some excess of fæces or flatus in the part, or some fresh descent of omentum or bowel. In cases of long standing the same result will ensue from the development of fat in the omentum, from adhesions between the sae itself and its contents, or owing to the existence of bauds traversing the sac, or to the intestine being caught between the folds of omentum.

On irreducible hernia.

The tonic or spasmodic contraction of the structures outside the neck of the sac under the influence of irritation, as well as the induration of the neck of the sac itself or of the surrounding parts, has also an important influence iu preventing the reduction of the tumour.

When the cæcum or large intestine forms the contents of the hernia, the rupture may be irreducible, from the fact that the peritoneum, which is uaturally adherent to these parts and is dragged down with them, becomes fixed to the tissues into which it is protruded. A cæcal hernia is, however, always difficult of reduction. In one case I had to puncture the bowel with a trocar aud canula, and draw off the air it contained before I succeeded. No harm followed this step, and the patient did well.

Cæcal hernia.

An irreducible hernia is always a source of anxiety and danger, because when composed of omentum a piece of intestine may at any time slip down behind it, and become caught in one of its folds; and, when composed of omentum and intestine, any accumulation of the contents of the bowel within the hernial sac may give rise to obstruction, and with this, strangulation of the hernia is not distaut. An irreducible hernia, moreover, is always liable to injury.

Prognosis.

Au irreducible scrotal or even femoral hernia will sometimes attain a large size. I have seen examples of both reaching half way down the thigh, but umbilical hernia will sometimes attain a still greater size.

May become large.

These forms of hernia also often give rise to dyspeptic symptoms, to irregularity of bowels and colicky pains, but the chief danger lies in their tendency to become strangulated.

Treatment.—A large irreducible *entero-epiplocele* must be treated by a bag truss; that is, with an instrument so adapted as to support the hernia, and prevent as far as possible its increase. A small irreducible hernia ought to be treated by a hollow truss. An *omental* hernia

Treatment.

may be treated by a truss, the pad being made of such a shape as to adapt itself to the neck of the tumour, and of such a substance as to seal the orifice of the sac without causing pain; air, sand, or india rubber being probably the best material for pads. Every patient with Bag-truss. such a hernia should be warned against taking violent exercise, or over-distending the abdominal viscera. The bowels should never be allowed to become constipated, and, above all, the slightest symptom of pain or increase of size in the tumour should be brought at once under medical advice, since these irreducible herniæ are treacherous things, and become obstructed and strangulated very insidiously.

A reducible hernia may become irreducible. In some cases of irreducible hernia, reduction may be effected by rest in the horizontal posture, a brisk purge or enema, and the administration of small doses of saline purgatives, such as the sulphate of magnesia, so as to keep up a gentle action of the bowels, with the *local application of ice*, the diet being at the same time nutritious, though not of a bulky nature. The late Mr. Bransby Cooper gave small doses of blue pill and tartar emetic, but I have not found such remedies necessary. In this way, in a boy, æt. 16, after a month's treatment, I have procured the reduction of a scrotal hernia that had been down three months; and an equally good result in the case of a gentleman, æt. 36, after three weeks' treatment, where both locally and generally, much disturbance existed. Old irreducible herniæ are rarely made reducible by treatment, but the recent can generally be reduced by the means already indicated.

Use of ice.

Example.

Obstructed Hernia.

Obstructed hernia. The *symptoms of an obstructed hernia* as of obstructed intestine are not very definite, but the chief are, obscure abdominal pains with a dragging sensation about the umbilicus after food, nausea, and, at times vomiting. Constipation, when present, aggravates the symptoms, and renders the *local signs* of obstructed hernia more marked, the tumour becoming distended, tympanitic, and painful. On manipulation, the intestine in the hernia may be partially or wholly emptied of its gaseous if not of its solid contents, and the compression of the tumour be accompanied by the peculiar gurgling sound of gas and fluid as these traverse the canal towards the abdominal cavity. When such symptoms are chronic, they are generally known as indicating an *incarcerated hernia*, but such a term is not satisfactory, it being applied to the obstructed as well as to the irreducible hernia, and should be discontinued.

Symptoms. Constitutional. Local.

When chronic.

Treatment. TREATMENT.—These cases require great care in their treatment, because if neglected, they pass on rapidly to inflammation or strangulation. *Rest* in the horizontal position is of primary importance, and the tumour if scrotal should be slightly elevated. *Warmth* to the hernia, also, often gives comfort, relaxing the parts, and thus favouring reduction.

Rest. Warmth.

Use of purgatives. When constipation *unaccompanied by vomiting* exists, a brisk purge may be given, but with this symptom a purgative enema is to be preferred, the natural action of the bowels being stimulated by these means, and the contents of the hernial sac moved on. The tumour itself should not be manipulated at this stage of the case, such a step doing harm by bruising or setting up inflammatory action. When

Avoid manipulation.

success does not attend these efforts and the symptoms persist, the source of obstruction will have to be sought by the surgeon as it will probably be mechanical, and the case have to be dealt with as one of strangulated hernia.

Inflammation of a Hernia.

An inflamed is not a strangulated hernia. Inflammation of a hernia is generally the result of some injury to an irreducible hernia, either from accident, a badly-fitting truss, or ill-advised manipulation, though an irreducible hernia after an attack of obstruction may inflame. A reducible hernia becoming temporarily irreducible and inflaming, may become permanently irreducible, adhesions forming within the sac between it and its contents. An inflamed hernia. Causes.

The local *signs* of an inflamed hernia are pain, swelling, and induration. When the tumour contains omentum, it becomes nodulated and irregularly hard; and when intestine, much fluid will be poured into the sac. When the action is enough to interfere with the natural function of the tube, symptoms of general peritonitis or obstruction will appear which must be dealt with on ordinary principles. Local signs.

Treatment.—*Rest* and the *local application of ice* in a bag are the most important remedies, also *purgatives* when obstruction in the hernia does not exist, and opium when it does. By such means, the symptoms are generally arrested; and, when this result does not take place the case passes on to one of obstruction, if not of general peritonitis. Treatment.

Intestinal obstruction and peritonitis as a result of the adhesion of a piece of intestine to the hernial sac.

On peritonitis following obstruction.

I published such a case in 1861, in part iii of my 'Clinical Surgery,' and Mr. Birkett, in his excellent article in 'Holmes's Surgery,' vol. iv, 1870, has given a second case with a drawing, which I also had the advantage of seeing, and he alludes to the fact that M. Littrè called the attention of the profession to the cases illustrated by the above in a paper, "Sur un nouvelle espèce de Hernie," 'Mém. de l'Acad. Royale des Sciences,' 1700, p. 300. The notes of my case are as follows:

Umbilical hernia; obstruction to the bowels from a sacculated adherent colon; death.—A woman, æt. 56, having had a hernia for many years, was suddenly seized some twenty-four hours before her admission into Guy's, under the care of Mr. Cock, with symptoms of strangulation. The taxis, under the influence of chloroform, proved successful, but collapse and death followed in twelve hours. After death, general peritonitis was found to have been present; the intestinal coils being all adherent. An umbilical omental hernia, the size of a fist, existed, the omentum forming a distinct sac. To the centre of this the anterior wall of the transverse colon was firmly adherent, forming a kind of pouch. The colon was, however, tolerably free. The intestines above this point were distended, and below it contracted and empty. The cæcum was of an enormous size, almost filling the lower part of the abdomen. It was here that the tension had been experienced; it was black, and in places the peritoneal coat was fissured, leading to the belief that but little extra distension could have been borne without a rupture taking place. The mucous membrane was also lacerated transversely, while the walls were so thin that they were nearly ruptured in handling, these con- Example. Distended cæcum.

ditions being such as we commonly meet with in cases of chronic intestinal obstruction.

In this interesting case, death had doubtless been caused by peritonitis, although not from the strangulation of the umbilical hernia, but from a partially ruptured and over-distended cæcum; a condition of bowel which had apparently been produced by the traction exerted upon the transverse colon, the result of the adhesion of its walls to the omental sac.

As elucidating a secondary result of hernia, this case must be regarded as most valuable; illustrating, as it does, a point not perhaps sufficiently recognised, namely, the influence of the adhesion of the bowel to a hernial sac, or the abdominal walls upon the functions of the intestines; since doubtless such adhesions are sufficient to account for many of the griping and painful symptoms which exist in an old and irreducible hernia. The case referred to must also be regarded as a good illustration of the result of a long-continued interference with the bowel's action; for the over-distension of the cæcum, with its attendant consequences, was apparently due entirely to the interference with its functions, resulting from the union of the walls of the transverse colon with the omental sac. The calibre of the colon itself was not materially diminished, but its power of acting had become paralysed; the greater the distension of the intestine above, the greater must have been the traction caused by the adhesion, and as a sequel, the greater was the effect of this interference. At last complete paralysis of the part had taken place, and complete obstruction, giving rise to all the symptoms and conditions which had terminated in death.

Influence of adhesion of bowel to hernial sac.

Over-distension of bowel paralysing its action.

Slight traction of portion of bowel may cause obstruction.

These cases tend to prove that the smallest traction of a portion of the calibre of the intestine in a hernia, or otherwise, although accompanied with an open passage of the bowel, is quite sufficient to interfere with the bowel's action, and at last even to cause complete obstruction. In a former page I have pointed out how strangulation of the bowel within the abdomen may result from the formation of bands associated with an external hernia.

Strangulated Hernia.

Mechanism of strangulation.

Whenever a knuckle of intestine slips through an opening in the abdominal walls (external hernia) or is constricted within the abdominal cavity (internal hernia) it is liable to become strangulated, and this result takes place when air or motion enters the upper extremity of the knuckle and distends it so as to compress its lower end against the neck of the constricting orifice through which it may have passed. Under these circumstances, the greater the pressure from above, the more the lower end of the bowel will be compressed, the more complete will be the obstruction, and the sooner the compressed or strangulated bowel will lose its life.

On strangulated hernia.

A rupture is said to be strangulated when its solid contents are so constricted as to be irreducible, and the vascular circulation of the parts is more or less completely arrested.

When occurring.

This may happen in its first descent, "*recent hernia*," but more commonly it takes place after a hernia has existed for many years, *old hernia*. An analysis of cases that I made in 1856 ('Guy's Reports') indicated that the average duration of an *inguinal* hernia previous to its becoming strangulated was twenty, and of a *femoral* eleven

years. The same analysis likewise showed, that it was a rare occurrence for an inguinal hernia to become strangulated in its first descent; and then when this occurred the *hernia* (recent) is generally of the "congenital" and not the "acquired" kind. Also, that femoral hernia was far more liable than inguinal to strangulation, and also to strangulation on its first descent.

Recent hernia more serious.

"Recent" strangulated hernia, that is, hernia strangulated on its first descent, both of the inguinal and femoral forms, requires operation more frequently than the "old" hernia, and is far more fatal.

It was also shown that *umbilical* hernia is less liable to strangulation than either of the two other forms, that it is little liable to strangulation in its first descent, and, that when strangulated it is almost always of very long standing.

Symptoms those of obstruction.

The symptoms of strangulated hernia are those of obstruction. In "*old inguinal hernia*" of many years' standing they are usually *chronic;* in "*recent hernia,*" and more particularly of the femoral form, they are *acute.*

General symptoms.

It thus often happens that in an acute or "recent" hernia, inguinal or femoral, its descent is accompanied by severe abdominal pain in the region of the umbilicus, more or less collapse, vomiting first of the contents of the stomach, then of those of the duodenum (biliary vomiting), and, at a later stage, of the yellow contents of the small intestine and even of fæces. Constipation is also usually present, although on the first onset of the symptoms, it is not uncommon for the large intestines to empty themselves. With these general symptoms of obstruction, the local signs of hernia will be present at one or other of the sites at which a hernia may occur, the hernial tumour will be tense and painful, and without impulse on the patient coughing.

Local signs.

The general symptoms thus described are common to every form of acute intestinal obstruction whether outside the abdominal cavity from a hernia, or inside from internal strangulation, ileus, or other cause; but, in every case in which they occur, the practitioner should carefully examine the site of every possible hernia, and not trust to the patient in any way, as the local are often masked by the severity of the general symptoms, and the local cause thereby overlooked.

Symptoms in old hernia.

The symptoms in an "old hernia" are less acute, and are those of chronic obstruction. They are not, however, less characteristic *when vomiting has set in;* but in all probability before this symptom appears the patient will have complained of some general abdominal uneasiness, such as flatulence, a feeling of faintness, nausea, and fulness, with local pain in the hernia; the nausea, however, will soon be followed by persistent eructations, hiccough, and vomiting; in most of the cases constipation too will be present, though in some the desire to go to stool will be great and the straining severe. The local signs of strangulation or obstruction are often so slight as to be disregarded by the patient, and unless the hernia is discovered by the surgeon, his attention will probably not be drawn to it by the sufferer. Thus, at Christmas, 1870, I reduced a femoral hernia by the taxis, strangulated for a hundred hours in a man who was unconscious of its presence till a few hours before.

Progress of hernia when unrelieved.

If the obstruction remain unrelieved the powers of the patient will probably become prostrate, and more or less complete collapse will show

itself, with a feeble pulse aud cold clammy skin. The vomiting also may diminish in intensity or even cease, at times remaining only as a passive pouring out through the mouth of the intestinal contents.

Collapse.

Pain previously severe may also suddeuly disappear. The collapse, indeed, may be so great that the parts about the neck of the sac become relaxed, and the hernia may go up either by itself, or by the gentlest pressure. Now, such symptoms indicate a serious collapse of the general power of the patient as well as a destruction of the parts strangulated in the hernia, since the reduction of the hernia is too often followed by a fatal collapse, death being usually, under the circumstances, the result of the shock to the nervous system from the severity or persistence of the symptoms. It may, however, occur from other causes, such as gangrene or death of the strangulated bowel, rupture of the bowel at the line of stricture, fæcal extravasation, or peritonitis.

Gangrene of bowel.

When gangrene of the bowel is the cause of death, the collapse may be as great as it is from shock, although of greater duration. Death, however, is slower.

Rupture of bowel.

When rupture of the bowel with fæcal extravasation is followed by collapse, it will have been preceded by symptoms of local or general peritonitis, or by a sudden severe abdominal pain; for in all cases of strangulated heruia, in which any delay in reduction has taken place, symptoms of inflammation of the protruded parts, of local peritonitis, around the neck of the sac, and suhsequently of general peritonitis, will be sure to show themselves.

Strangulated omental hernia.

Strangulated omental hernia is characterised by the same symptoms as the intestiual, though less marked and acute. The paiu is not so severe, nor the vomiting so constant, constipation is less complete and insuperable, while the constitutional symptoms are also milder. The local distress is likewise incousiderable, the tumour feeliug harder, more nodular, and like to an ohstructed hernia, permitting manipulation more freely than when it contains intestiue. As time progresses, however, symptoms of inflammation in the hernial tumour will show themselvcs with those of local peritonitis, and when these appear, they are as severe aud destructive as they are in other forms of strangulated hernia. In exceptional cases, however, the omeutum may slough.

A strangulated omental hernia requires, consequently, as active surgical treatment as any other, as it leads to the same end—a fatal peritonitis.

Pathological changes, the result of strangulation.

Pathological conditions of strangulated bowel.

These are the same when they take place within the abdominal cavity as in an exterual hernia, and under both circumstances, the first effect of the *partial* arrest of the circulation through the parts is congestion—this congestion being associated with its usual accompaniment, *serous effusion*. When *complete* arrest has taken place the congestion will be more thorough, the surface of the bowel appeariug of a red purple or blackish hue, and the tissues themselves thickened from effusion into their meshes or blackened, wholly or in spots, by extravasated blood (Fig. 273). Wheu they have been much manipulated by the "taxis," the extravasation of blood iuto the

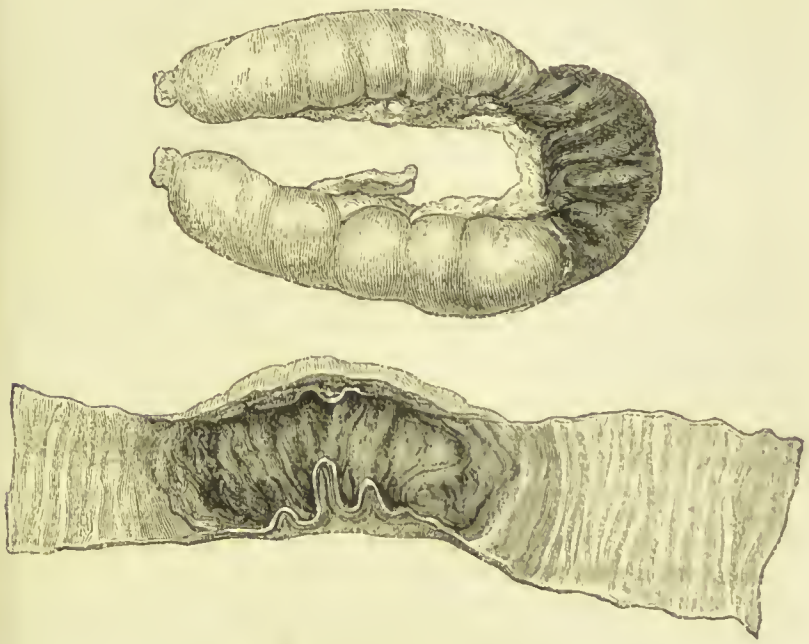
Serous effusion.

Extravasation of blood.

tissues is often very marked, the degree of congestion depending upon the intensity of the strangulatiou.

When, however, the strangulation has been acute or of long standing, and an inflammatory action been added to that of congestiou, the bowel will not only be swolleu but soft, the natural glistening aspeet aud elasticity of its coats having become changed for a dull appearance and leathery eondition. Its serous surface may indeed be covered with a layer or with flocenli of lymph, or the knuckle of intestine may be wholly or in part soft and gangrenous, with ash-coloured spots on its surface, and even perforations. Inflammation.

Fig. 273.



Drawing 481⁶. (Birkett.)
Effects of severe strangulation of the bowel.

At the neck of the sae other changes will also be found, and these depend materially upou the eharacter and seat of the coustricting force. Thus, when the linc of a straugulatiou is rigid aud linear, as it is in direct inguinal and femoral hernia, the kuuckle of strangulated bowel, either as a whole or in part, may be rapidly destroyed by gangrene. And when the pressure is more diffused and less rapid, as in large ingninal hernia, ulceration of the mucous membraue at the line of stricture, even to perforation, is more eommon—the grooved or suleated conditiou of the serous surface in the liue of stricture being found in both. Changes at neck of sac. Ulceration of mucous membrane.

Within the abdomen every indication of peritonitis from the mere greasy condition of peritoneum to fibrinous or even suppurative effusion may be met with. In most cases local peritonitis will be found about the seat of hernia, and in some the peritonitis will be general. The straugulated portion of bowel will almost always be found at the Peritonitis.

neck of the sac, if not adherent to it, with more or less matting together of the neighbouring coils.

That this peritonitis is to be directly attributed to the strangulation of the intestine is generally acknowledged, few cases of strangulated hernia remaining long unrelieved without local or general peritonitis making its appearance. It is also indisputable that this peritonitis is often aggravated, and at times caused by the reduction of the inflamed and injured contents of the hernial sac into the abdominal cavity; but to assert with Mr. Hutchinson and M. Girard, that in the bulk of cases it is the return of the intestine into the abdomen that gives rise to the peritonitis, is an assumption which facts hitherto known do not bear out.

Sloughing of bowel.

When the intestine has sloughed wholly or in part and discharged itself through the wound, an artificial anus is said to exist. This result is far more common after femoral than inguinal hernia.

When the bowel subsequently ulcerates after its reduction, either at the line of stricture as it may in inguinal hernia, or, at the centre of the knuckle as is the more common in femoral hernia, extravasation of fæces may take place, half of these cases of extravasation being either general into the peritoneal cavity and fatal, or local about the neck of the sac.

Statistics of artificial anus.

The following facts, published by me in 'Guy's Hosp. Rep.,' 1856, on the causes of death in hernia, will tend to prove these points. Out of 17 cases of artificial anus after hernia, 13 were femoral, 3 inguinal, and 1 umbilical. Out of 15 cases of gangrenous bowel, 11 were femoral, 4 inguinal. Hence, out of 32 cases of gangrenous bowel, 24 were femoral, 7 inguinal, and 1 umbilical, clearly proving that *gangrene of the intestine and artificial anus are more common after femoral than inguinal hernia.*

Of 15 cases of hernia in which the strangulated bowel was found perforated, 10 were femoral and 5 inguinal; in 4 the perforation was at the line of stricture, all being inguinal; in 11 the perforation was in the centre of the knuckle, 10 being femoral. In 8 of these 15 cases extravasation of fæces was prevented by inflammatory exudation sealing the aperture. In 7 it existed, but in 5 only of these was it general; in the other 2 it was local. Of these 7 cases, in 2 the taxis was the direct cause, in 1 gangrene, both being cases of femoral hernia; in 4 ulceration at the line of stricture was the cause, all being inguinal.

From these facts it is evident "that ulceration in the line of stricture with fæcal extravasation is more frequent in inguinal than in femoral hernia, and that when it is found in the latter, it is generally from rupture of the bowel from forcible taxis."

Stricture of small intestine after hernia.

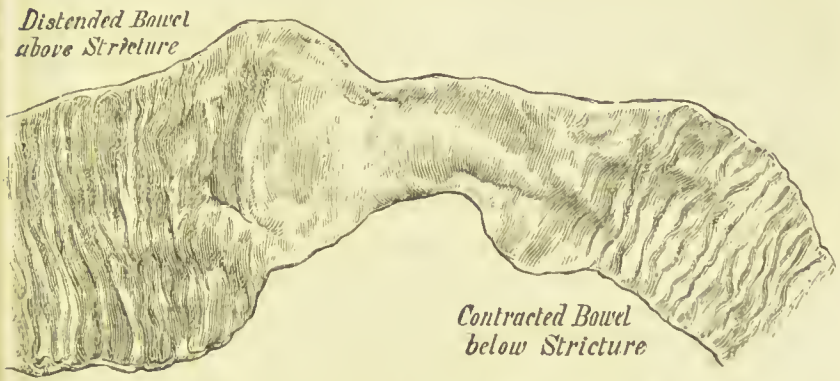
As a result of a strangulated hernia, I must mention a stricture of the intestine due to contraction of the bowel that had been strangulated. A unique example of which took place in my practice in 1870 in a woman, æt. 52, upon whom I had operated for strangulated femoral hernia of thirty hours' duration, without opening the sac. Convalescence followed the operation, but about the seventh week vomiting appeared, and death took place in the eleventh week from intestinal obstruction. After death a complete stricture of a knuckle of bowel was found (fig. 274).

Fluid in hernial sac.

The fluid found in the hernial sac varies according to the condition

of its contents. In the early period of strangulation, when the contents of the hernia are merely arrested and the circulation impeded, simple serum will be found. When an extreme congestion exists, the serum will be more blood-stained. In even worse examples where blood has

FIG. 274.



Stricture of intestine after strangulation.

Stricture of the small intestine after strangulated hernia.

been extravasated into the tissues, the fluid will contain blood elements or blood itself. When the hernial contents are inflamed, flakes or flocculi of lymph will be found floating in the dark fluid. When the bowel is gangrenous, fœtor will be observed. When perforation has taken place, fæces will be mixed with the fluid, and often gas. When the hernial tumour is red, infiltrated, and emphysematous, the surgeon may safely infer that sphacelus of the gut exists.

Thus, the condition of the fluid and the external aspect of the sac are valuable aids to diagnosis and prognosis in strangulated hernia.

Treatment of Strangulated Hernia.

Treatment of strangulated hernia.

When a hernia is strangulated, nothing but its immediate reduction should be entertained, as delay is highly dangerous. In the surgeon, indeed, it is criminal, since every hour of strangulation adds to the risk, which it is his duty to diminish. This can be done by manipulation, or by what is technically called "the taxis," and when this fails, by "the operation" of herniotomy.

Taxis.

Chloroform.

To aid the surgeon in the adoption of these means, the use of an anæsthetic cannot be too highly praised, as it contains within itself all the advantages of every other form of treatment without a single disadvantage. It renders the reduction of a hernia by the taxis a gentle, and comparatively simple measure, and, certainly, a far more successful one than of old. It facilitates also the operation of herniotomy on the failure of the taxis. Indeed, in strangulated hernia the value of an anæsthetic is so great that I would urge, where it can be rendered available, that the taxis should never be employed without it, and, that on the reduction of the hernia failing to be accomplished, "the operation" ought to be performed. The warm bath, the administration of opium, the injection of tobacco, the local application of ice, for strangulated hernia being, in comparison, poor and unreliable remedies. In *obstructed* or *inflamed* hernia, however, they are still of use, but in *strangulated* intestinal hernia, recent or old, inguinal,

femoral, obturator, or umbilical, chloroform, the taxis, and operation, are the three great means of securing reduction upon which the surgeon ought consecutively to rely. The taxis, however, is not equally successful in every form of strangulated hernia.

In *inguinal* cases, two thirds, at least, are reduced by the taxis, a large proportion of these being successfully treated with the patient under the influence of chloroform, when the taxis without chloroform fails. Strangulated old heruiæ are also more successfully treated by the taxis than recent cases, which are seldom reduced by this method.

In *femoral* hernia, on the contrary, the taxis is not half so successful as in inguinal, and much more fatal. It is most successful in "recent," whilst in old cases it seldom succeeds.

In *umbilical* hernia two thirds of the cases are reducible by the taxis.

The Taxis.

Mode of applying taxis.

With the patient under the influence of an anæsthetic and placed on the back, the shoulders raised and the legs partially flexed and rotated inwards—in order to relax all the parts that can possibly affect the neck of the sac—the surgeon should steadily grasp with the fingers and thumb of one hand the neck of the sac, so as to fix it and at the same time prevent the contents of the sac on being pressed from bulging round the orifice. Then with the other hand he should raise the tumour, if large, and gently compress it so as to empty it of its serous, gaseous, fæcal, or venous contents, and thus lessen its size. Having done this, he should draw the tumour first to one side and then to the other with the view of opening the constricted lower end of the strangulated gut and allowing the contents of the bowel to pass onwards. He should remember that this *cannot* be effected by any direct pressure upon the hernial tumour itself, but it *may be* by lateral; for if the slightest movement of the lower or constricted end of the knuckle can be made in the direction of the upper or distended one, the lower opening will probably be freed and the reduction of the hernia effected by its sudden rush backwards into the abdominal cavity, when the surgeon may be assured that all is well. But when the tumour has diminished in size, and its diminution has not been accompanied by the well-known sensation, a feeling of doubt should ever remain in the mind as to the result, since the want of this symptom of proper reduction should suggest the possibility of a rupture of the bowel, or of a reduction into one or other of the unnatural pouches which are now known to exist under certain circumstances at the neck of an inguinal hernia. To facilitate reduction, a *gentle* kneading movement of the fingers at the neck of the sac may be made in inguinal heruia, as well as a steady traction downwards of the tumour, this traction rendering the neck of the sac a straighter channel for the hernial contents to pass through. With a similar object the sac itself may at times be pinched up with the fingers of one hand and drawn downwards. Violence in manipulation is unjustifiable under all circumstances, and, in proportion to the period of strangulation as indicated by the vomiting, is the danger increased. In femoral hernia also it is comparatively much more injurious than in inguinal, for not only may the bowel be ruptured by forcible taxis (an accident more common in femoral than inguinal hernia) ('Guy's Rep.,' 1856), but it may be so bruised as to be irreparably injured. A preparation and drawing (Fig. 273) in Guy's

Its rush upwards.

Gentle kneading at neck.

Force unjustifiable.

Museum show such extravasation of blood into the strangulated bowel of a femoral hernia as to cause its complete death, this being clearly due to forcible taxis.

Where evidence exists that gangrene of the contents of the sac has taken place, or where, indeed, there is a suspicion of such a result, the taxis must not be used. In recent or old femoral hernia, where fæcal vomiting has existed for some hours, the taxis is a dangerous practice, and in all old cases it is so unsuccessful that reduction by herniotomy is a more certain and safe method. If there be hiccough, the taxis is inadmissible. The taxis may succeed without chloroform, but, as a rule, with the patient under chloroform, a hernia that is capable of being reduced by the taxis returns on the gentlest manipulation, and when such a result does not follow force will not only be unsuccessful, but also prove injurious. Taxis inadmissible when bowel gangrenous.

When the taxis succeeds, vomiting usually disappears, although it may be kept up to a slight extent as an effect of the anæsthetic. The abdominal dragging pain will, however, be at once relieved. After the reduction of the hernia, a pad should be carefully adjusted over the neck of the sac to guard against its re-descent, and, when the patient has a cough, the necessity of doing so is increased, as I have known the hernia descend and a renewal of all the symptoms take place from a want of attention to this point; indeed it is wise to adapt a pad till a truss has been obtained. The patient under all circumstances should be kept at rest for a few days after the reduction of a strangulated hernia. The diet, too, should be nutritious but not solid, till the bowels have acted spontaneously, and no aperient under any but exceptional circumstances should be administered, for the bowels will to a certainty act as soon as the effects of their strangulation have passed away, and they have recovered their natural tone. If, however, abdominal symptoms appear which can be attributed to a want of the natural action of the bowel an enema may be given, and repeated with advantage when required. Stimulants should be used with caution. When the bowels have acted naturally the patient may be pronounced convalescent, and the ordinary diet, &c., allowed. Treatment after reduction. Avoid aperients.

Where chloroform is not at hand, or cannot readily be obtained, a good dose of opium, such as a grain and a half of the solid or thirty drops of the tincture may be given and repeated to an adult, for when a patient with an old hernia is brought fully under the influence of this drug, reduction may often be obtained by manipulation. In the very earliest hours of strangulation, before vomiting has become severe or passed beyond stomach vomiting, this practice is also at times successful. It may be tried moreover when the surgeon cannot obtain the patient's consent to perform herniotomy, and reduction has not been effected by the taxis under chloroform, or when time has necessarily to be lost in making arrangements for operative relief. Under the same circumstances, a *hot bath* (99° F.) may be used. The local application of ice should be employed in *old* cases of hernia where the symptoms are chronic, and delay is a necessity or expedient. In omental hernia also it is particularly valuable, and should be applied over the whole tumour in a loose bag. A purgative is never admissible with a strangulated hernia. Opium. Hot bath. Ice.

The taxis with inversion of the body, the legs flexed, pelvis raised, and shoulders depressed, has been successful in causing the reduction Taxis with inversion of the body.

of a hernia. On a bed, it may be done by pillows placed below the pelvis; but if one of Alderman's chairs or a lithotomy couch is at hand, it may be used. Some surgeons, with the patient in the recumbent position, and a folded sheet placed round the abdomen over the umbilicus, have forcibly drawn the contents of the abdomen upwards. Both these methods are founded on the principle of withdrawing by position and force the contents of the sac into the abdominal cavity. They are *possibly* justifiable when herniotomy is not sanctioned nor chloroform employed, and delay is dangerous. I cannot recommend them.

Prolonged taxis to be avoided.

The taxis should never be employed for any lengthened period. With the patient under chloroform, a femoral hernia of average size (that of a walnut) should never be manipulated for more than two minutes; half that time, or less, is usually sufficient to effect reduction where it is to be secured, while any more prolonged effort will be injurious. The taxis should never be forcible. In large femoral herniæ, inguinal or umbilical, five minutes may possibly be allowed; but the quarter and half hour's manipulation so frequently talked about, is dangerous in the extreme. In very large herniæ, ten minutes may be permitted without chloroform, and periods half as long again may possibly be called for. It is from this fact, coupled with another, viz. that without chloroform twice the force is needed, that the use of the anæsthetic is to be recommended.

The reduction of a hernia by *gentle* taxis with a patient under chloroform is a simple, rapid, and successful operation. The reduction of a hernia by *forcible* or prolonged taxis without chloroform is a dangerous and far less successful proceeding. In femoral hernia, indeed, herniotomy had far better be employed. Under chloroform, the taxis is almost always successful in inguinal hernia.

Operative measures.

When the taxis has failed, nothing but an immediate operation is justifiable. The operation is not of itself dangerous, although the condition that demands it is exceedingly so. It is not, and should not be regarded as a last resource; for in many cases it should be the first. When a patient is hanging, the first thing any one does is to cut the rope that is causing strangulation; and no other means are admissible. When a piece of bowel is strangulated, the strangulating medium requires division to give it freedom; the doing of it adding nothing to the danger of the case. The danger lies in the strangulation which increases every minute.

Herniotomy.

Herniotomy or Kelotomy

remains now to be described, and let it be repeated, *that it is to be performed directly the reduction of a strangulated hernia by the taxis has failed, and, if chloroform is used, while the patient remains under its influence.* To submit a patient to the depressing effects of chloroform to apply the taxis, and, on its failing, to allow any period of time to pass before resorting to herniotomy is a practice to be condemned—a second administration of chloroform for the operation having no beneficial influence. It would be better for the patient and far better practice to delay the application of the taxis till chloroform can be obtained, and the arrangements for operation made, in case the taxis fails.

Objects of operation.

The objects of the operation are to liberate the strangulated hernial

contents, and, in a general way, to return them into the abdominal cavity, exceptional cases occurring in which it is better practice to leave them in the sac wholly or in part; and others, in which it is impossible to reduce them; but to these points attention will be directed further on.

Division of stricture.

Its seat.

To liberate the strangulated hernial contents, the cause of the strangulation must be divided; and, as previously shown, this may be found in the tissues outside the sac, in the neck of the sack itself, or in the contents of the sac.

When the cause of constriction is found outside the sac as is usual in femoral hernia, the opening of the sac is rarely needed, division outside being all that is required.

When the neck of the sac is the seat of obstruction and prevents reduction, an opening into it sufficient to allow of its division is all that is necessary. When the difficulty lies in the contents of the sac, the surgeon will be required to lay the whole open, and to expose it in order to its removal. But it should be remembered, that the less the contents of a hernia are exposed and consequently manipulated the better are the results; also when all that is desired can be secured by the division of the tissues outside the sac, there is no need of doing more; and that when the division of the neck of the sac allows of the reduction of the hernia, a greater exposure of the contents of the sac is unnecessary and wrong, for in hernia as in all surgical interference, the surgeon should carry out his objects in the simplest way his art can allow, and should never allow himself to do more than the absolute necessities of the case demand. Meddlesome surgery is always bad, but in hernia is too often fatal.

These remarks, however, are only entirely applicable to cases of strangulated hernia in which the whole contents of the sac are reducible; since when *some portion remains behind*, a feeling of doubt may at times remain as to the thoroughness of the reduction of the strangulated portion or the condition of what is left, and, under these circumstances, it is usually advisable that the sac be opened and explored; yet it is better to do so after the partial reduction of the hernia, when, in all probability, the strangulated bowel has been reduced and is consequently out of harm's way, than with the whole contents of the sac *in situ*, and when they may be exposed. When the *hernia cannot be reduced without opening the sac,* the whole must necessarily be explored. It will thus be seen that the question of opening or not opening the sac resolves itself into the necessities of the individual case. Where reduction can be effected without it, the "minor" operation is sufficient; where reduction cannot be effected by the "minor" the "major" operation must be performed.

When sac should be opened.

Arguments on the opening and not-opening the sac.

The surgeon who opens the sac in *every* case, clearly often does what is unnecessary. He who opens it only when reduction cannot be effected without so doing, or when any uncertainty exists as to the condition of the parts contained in the sac, is free from such an error, "and although we dare not venture to say that some of the fatal cases which have occurred after opening the sac might have terminated differently had it not been incised, we do not hesitate to affirm, that the untoward circumstances stated as likely to happen when the sac is not opened, have not occurred" (Birkett). This view is supported by my analysis of 126 fatal cases of hernia ('Guy's Rep.,' 1856) in which

I proved fairly that in no single fatal ease eould the opening of the sae have had the slightest influence in retarding or preventing the fatal result, as well as by my twenty-two years' experience. The surgeon who advoeates the major operation, in most eases will try the taxis, and, I take it, is always well pleased to effect the reduetion of a hernia by sueh means. The operation of herniotomy "external to the hernial sae" differs only from the taxis in the skin wound, yet in what way the neeessity for that wonnd renders the taxis an nnsafe measure, it is difficnlt to eonceive. It would be as reasonable to rejeet the administration of ehloroform for the renewed applieation of the taxis in eases where it had failed to reduee the hernia without its aid, as to say, that beeause the taxis had failed and a cutting operation is demanded, the oeular inspection and manipnlation of the strangulated and therefore already injnred bowel is required. To argue that the liberation of a strangulated bowel is not eomplete nntil it has been carefully examined, and that moreover without opening the sae, a hernia that is strangulated by omental or other adhesions or by the neck of the sae, may be redneed, are objeetions which, if applicable at all, are as forcible against the taxis as any operation, and are indeed of little weight.

The operation of herniotomy without opening the sac, has been ably advocated by Petit who first adopted it in 1718, by Munro in 1770, Aston Key in 1833, Lnke, and others.

So far as statistics are of value towards the solntion of this matter, they are in favour of *not* opening the sae. Thns out of 59 eases of strangnlated femoral hernia operated npon at Guy's Hospital in eight years, in whieh the sae was *opened*, the mortality was 50 per eent., and, ont of 45 cases in whieh the sae was *not opened* it was only 30 per eent.—the differenee between the two elasses of eases being 20 per cent. in favonr of the minor operation.

Statistics in favour of not opening the sac.

Out of 35 cases of inguinal hernia in whieh the sac *was opened*, 60 per cent. died, and out of 9 in which the sae was not opened two, or only 22 per cent., died; the differenee between the two elasses in inguinal hernia being 40 per eent. in favour of *not opening*. But it mnst be remembered, that as a rule, the eases in which the sac was *not* were of a more favorable kind than those in which it *was* opened.

In nmbilieal heruia it is a rare thing, however, to save a patient after opening the sac and exposing its contents, though when this is not doue, a good result may be looked for.

When sac should be laid open.

Whenever *the taxis is applicable* to a strangulated hernia and fails heruiotomy without opening the sae is applicable, and, where reduetion is effected nothing more is needed. Where rednetion eannot be effected, or a donbtful something remains in the sac, where the eontents of the sae have not gone baek with their normal rush, or the symptoms persist, and any doubt abont the condition of the parts at the neek of the sae is raised, an exploration of the sae and its neek is absolutely necessary.

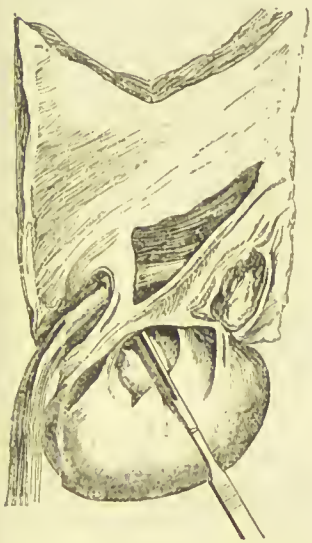
Whenever *the taxis is inapplicable*, that is, when the strangnlation has been of long dnration, the symptoms severe, fæeal vomiting persistent, and the loeal as well as general symptoms indicate the probability that the strangulated gnt has died or is dying; wheuever, moreover during the applieation of the taxis—by the snddeu eollapse

or yield of the tumour without its reduction—the fear is excited of some rupture of the bowel having taken place, herniotomy by the minor operation is inapplicable, and the sac must be laid open.

The operation itself.—The patient having been brought under the influence of chloroform, should be placed with the shoulders slightly raised, and the knees flexed upon a pillow, then the integument over the seat of hernia should be shaved of all hair; an incision can then be made over the neck of the sac, that is, in inguinal hernia, along the line of the inguinal canal, from the internal to below the external ring; in femoral, over or on the inner side of the crural ring either in a vertical or oblique direction in the course of Poupart's ligament, the former being preferable. In this incision all the soft parts should be cut through consecutively down to the sac, each layer of tissue being divided the full extent of the wound, while all vessels as they bleed should be twisted. Mode of performing the operation.

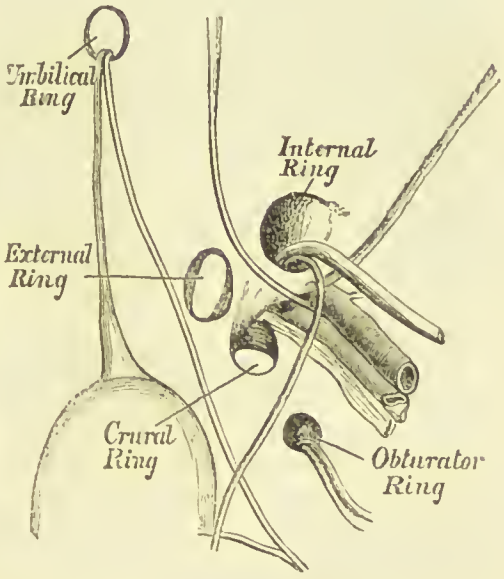
When the sac has been exposed, the seat of stricture outside its neck must be felt for with the index finger, and, when felt, a director may be carefully passed beneath it, Aston Key's director, shown in Fig. 275, being by far the best. Sac to be exposed.

Fig. 275.



Key's director passed beneath the seat of stricture of a strangulated femoral hernia outside the sac beneath the fascia propria. Taken from his work on 'Hernia.'

Fig. 276.



Drawing to illustrate the relative position of all the abdominal rings from within.

With a hernia knife, such as that figured (Fig. 277), straight or curved, or herniotome (Fig. 277), the stricture should then be divided, the incision *upwards* being the safest to avoid the epigastric artery (Fig. 276) This division must not be too free—a quarter of an inch being generally ample in a small hernia. It should, under all circumstances, be only enough to allow of the return of the hernia without force. It is better to have to extend it than to make it too large at first. The Division of stricture outside sac.

Sac to be opened on failure of reduction.

stricture having been divided outside the sac, reduction by the gentlest manipulation can then be attempted, and, when the contents of the sac go back with a rush, all the surgeon needs has been effected. When no indications of reduction show themselves, or a portion of the contents of the sac has disappeared, but not with the characteristic jerk, or some piece has been left behind, the sac must be opened. To do this, care is needed, the danger of carelessness consisting in wounding the bowel. To avoid this, the sac may be nipped between the thumb and finger, or seized with forceps, and, being slightly raised, opened with a scalpel applied laterally. Through this opening a director should be passed, its point being kept close to the walls upwards towards the neck of the sac, and downwards towards the fundus, the sac being divided upon it with a bistoury of the sac. The escape of fluid usually indicates the opening of the sac, and the character of the fluid the condition of its contents But fluid does not always run away when the sac is opened, and at other times, the escape of fluid from a cyst on the hernial tumour may mislead. The sac having been opened, its contents should be examined, and in doing this the utmost gentleness must be employed. When a *knuckle of intestine* is present, and is neither gangrenous nor perforated, the abdominal cavity is its best place. It may be black from congestion, and spotted from ecchymosis; it may be granular from lymph, or even covered with false membrane; but, as long as it possesses its living resiliency, is not fœtid, flaccid, like wet wash-leather ruptured or perforated, it should be returned.

Examination of contents.

Care in dividing the neck.

When a *large quantity of injured intestine* is found in the sac, it had better be left, the surgeon simply relieving the constriction by the division of the cause of stricture, and this ought to be done with the utmost care. The director when employed, should be kept close to the walls of the sac, and guided by it towards its mouth. Its point should

Fig. 277.



Hernia knife.



Herniotome director—A, Blade withdrawn; B, Blade exposed.

be carefully kept away from the bowel, and not introduced further into the abdominal cavity than to ensure the safe division of the stricture, and, when the knife is passed along its groove, the finger of the operator should carefully press the strangulated bowel away from it in order to protect it from injury. The finger, however, is the best director and should be introduced to the neck of the sac, with the knife upon it, having its side pressed into the pulp of the soft parts. Both being

Finger best director.

thus reached the neck, the knife may be carefully turned upwards and the tissues divided, the point of the finger measuring the extent of the incision.

When a herniotome such as that figured (Fig. 277), is used, no director need be employed.

When the *intestines are adherent* to the sac or to one another by filamentous or soft adhesions, these may be divided, though such are only met with in recent hernia. The fibrous adhesions of old herniæ had better be left alone, and the hernia considered as irreducible, the surgeon being satisfied, under these circumstances, with dividing the stricture, and thereby relieving the strangulation, but not attempting its reduction. If a fresh piece of bowel comes down, this should be reduced, but the old hernia ought to be left. When intestine adherent.

The strangulated intestine, under all circumstances, should be handled with extreme delicacy. *Any drawing down of its neck* to examine its condition should be avoided, since such an act can do no good, but often does much harm, in tearing away adhesions that would have sealed an ulcerated orifice, prevented extravasation, and assisted repair. *Any introduction of the finger* into the abdominal cavity is also to be condemned, save under exceptional conditions. With the careful return of the bowel to the neck of the sac, surgical interference ought to cease. The surgeon may satisfy himself that such an end has been obtained without probing the abdominal cavity with his finger, and thus risking life by tearing away adhesions, and undoing in a moment what nature by her own processes had probably being attempting from the first period of strangulation, to shut out from the general abdominal cavity what might prove injurious and dangerous to life. Care in handling bowel. Avoid useless exploration.

When the *bowel is dead*, as indicated by its flaccidity and ashy colour, all thought of its reduction must be abandoned. The soft parts covering in the sac with the sac itself, should be freely laid open, so as to expose the whole sloughing mass, *and the intestine left to nature*, to pass into what is called an "artificial anus." The neck of the sac may, however, be carefully divided, not, however, with the view of relieving the strangulation, for the gut having become gangrenous, no strangulation exists, but with a view of allowing the intestinal contents to escape when an external opening takes place, and should life be spared, for the subsequent retraction of the bowel towards the abdominal cavity, to effect a natural cure. When bowel is dead.

No free incision into the gangrenous bowel, no stitching of the intestine to the margin of the wound, is required. as fæces will soon find their way through the opening that has been made by the artificial anus, and the surgeon may be certain that within the abdomen, sufficient repair has gone on to fix the intestine that had been strangulated to the neck of the sac, and thus prevent its immediate retraction; for it must be remembered, that as time goes on, this retracting process is precisely that which nature adopts to procure a spontaneous cure of an artificial anus. Free incision.

When the *bowel is perforated by ulceration or ruptured*, and the opening is not large, the neck of the sac must be incised as in an ordinary case, and the intestine that appears reparable replaced, the perforated or ruptured portion being left at the mouth of the sac. When the rupture or perforation is small, there is no objection to the surgeon placing a ligature round the wound and replacing the When bowel perforated or ulcerated.

gut in the orifice of the sac, for plastic lymph will probably be poured out within a few hours, and the parts sealed from the abdominal cavity.

When bowel is in doubtful condition.

When *the bowel is in a doubtful condition*, and the surgeon is not certain whether he can say it is irreparably dead, or going to die, the abdominal cavity is still its best place, when it can be returned. Aston Key advocated this plan many years ago, and modern experience has not disproved its value. "The danger of abdominal extravasation will not be increased by replacing the injured bowel at the neck of the sac; for, should sloughing of its coats ensue, the slough may be walled in by adhesion of the surrounding peritoneum and fæcal extravasation be prevented." (Key, 'Guy's Rep.,' 1842.)

Causes of death in hernia.

In an inquiry in 1856 into the causes of death in hernia founded on an analysis of 156 fatal cases, the same conclusion was arrived at. The weight of evidence led me then to express the opinion that there is only one condition of intestine in which its reduction to the neck of the sac is not advantageous, and that is, when it is decidedly ruptured by gangrene or ulceration, my own materials tending to support the opinion of Mr. Aston Key, as stated to the writer, in 1849, "that in all conditions of the intestines, the abdomen was their right place."

Mr. Hutchinson, who believes peritonitis to be the direct result of the reduction of an injured bowel into the abdominal cavity, advises in all cases that the damaged gut, if found in a bad condition, should be left in the sac; while Dr. Girard goes further, advising the contents of the hernia, under all circumstances, to be left—the surgeon contenting himself by freely dividing the stricture. I cannot concur in this practice, nor with the principle on which it is based.

When the contents cannot be returned on account of adhesions, the neck of the sac should be incised and the case left to nature. In large umbilical herniæ also, this practice is valuable.

When omentum in sac.

When omentum is found in the sac with intestine, and has only *recently* descended, it may be returned. When it has been down for some time, is irreducible, and is only a small piece, it should be left alone; the omentum, doubtless, often acting as a plug to the orifice of the sac. When it is diseased or in large quantities, it should be ligatured in two or more portions and cut off—the ligatures being applied as near to the neck of the sac as possible, care being observed not to disturb the parts at the neck.

Risks in removing omentum.

Simply to cut off the omentum and to tie or twist the vessels is risky, the omentum always being highly vascular, and small vessels being apt to bleed much; indeed, cases are on record in which a fatal hæmorrhage supervened after this practice. When diseased omentum is left in the sac, prolonged suppuration often follows. Whenever intestine and omentum are found together in a hernia, much care is required. The intestine is generally to be sought for behind the omentum, but is often wrapped up in it, and, in not a few cases, covered by an omental sac. Under all these circumstances, the intestine should be exposed and carefully reduced, care being taken that no adhesions at the neck of the sac or no bands, bind the bowel down to the omentum thereby keeping up the strangulation. An omental sac is on no account to be returned into the abdomen unopened. Omental sacs are generally found in femoral hernia. An interesting paper by Mr. Prescott Hewett ('Med.-Chir. Trans.,' 1844) may be referred to on this subject.

Treatment after herniotomy.

After-treatment.—When a hernia has been returned into the abdominal cavity, the more the case is left to nature the better. As a matter of precaution after the operation, as after its reduction by the taxis when the wound has been brought together with strapping or suture, a pad may be adjusted over the part with a spica bandage (Fig. 278).

A suppository of half a grain of morphia or more should be at once introduced into the rectum, and repeated in an hour should pain render it necessary; a little ice, too, may be allowed for the patient to suck, when thirst is great, but the less that is taken by the mouth the better. When the powers are very feeble, brandy, soda-water, and ice may be given in small quantities.

If no chloroform sickness complicate the case after the first twelve hours, beef tea, arrowroot, or milk, may be given, a pint or a pint and a half in the twenty-four hours being ample. Stimulants should be allowed as the powers of the patient indicate, but always with caution.

Fig 278.



Spica bandage.

On the second day, the wound should be dressed, water dressing being all that is usually required, the lower end of the wound being left open for the escape of discharge. Should pain continue and symptoms of peritonitis appear, the opium or morphia suppositories can be repeated twice a day or more frequently; indeed, the patient should be kept under the gentle influence of opium till the symptoms are relieved; hot fomentations should also be applied to the abdomen. Purgatives ought never to be given if the bowel has been bruised or otherwise injured by its strangulation, for as soon as it has recovered its tone, its natural action will return, any goading of it to action by medicine doing much harm. "A bruised bowel," says Aston Key ('Guy's Rep.,' 1842), "is placed by nature in a state of rest; the exhaustion of the nervous energy of the part diminishes in the muscular tissue the disposition to contract. *Such inactivity of the bowel should be encouraged and not thwarted* by irritating purgatives. The surgeon's anxiety to procure stools should yield to the evident necessity for time being allowed for the restoration of the natural powers of the injured bowel."

Opium.

Avoid purgatives.

Three, five, ten, or even twenty days may be allowed to pass without any action of the bowels, without anxiety or without purgatives, so long as no other indications of mischief show themselves, but during this time only liquid food is to be given with stimulants as may be required. When some local distress is present, which the surgeon can fairly attribute to the constipation, an enema of gruel and olive oil may be administered, which may be repeated if necessary, such a simple intestinal stimulant being usually sufficient to induce the bowel to act should it have recovered its tone. When the bowels have acted naturally, convalescence may be declared and the usual diet allowed.

When enema to be used.

Any violent action of the bowels soon after the operation must be watched with anxiety, and in the aged it is too often followed by a fatal collapse. When too profuse it must be checked by opium. The patient on no account should be allowed to get up and walk until he has been fitted with a good truss.

Persistency of symptoms.

It occasionally happens that, after the reduction of a hernia by operation, the symptoms of strangulation persist, and the surgeon is in doubt as to their cause. Under these circumstances, the wound may at times require reopening, and the parts at the neck of the sac re-explored, since the case may be one of those of "displaced herniæ" to which attention is now to be drawn.

As a rule, however, the persistency of the symptoms is due to the obstruction caused by the injured bowel, or to the anæsthetic.

When the bowel, however, has not gone up at the time of the operation with the usual rush, or the surgeon has any doubt in his mind as to its right reduction, the wound should be reopened, the utmost caution being observed by the surgeon in examining the parts about the neck of the sac.

Multiple Herniæ.

Multiple herniæ.

When *two or more herniæ* exist with symptoms of strangulation, the one that on careful examination appears to be the most tender ought first to be explored, and should this operation not give relief, the second should be treated in a like manner; indeed, if no relief be given by the second operation and a third hernia exist, it should also be explored, for it cannot be too often repeated, that the operation is not one of danger when compared with the necessity of the case that demands it. Dupuytren in his "Leçons Orales" has recorded such a case. In the third part of my "Clinical Surgery," p. 204, I have likewise recorded another in which Mr. Cock was the operator. The patient was a man æt. 70; the left side was first explored, but as the symptoms continued the right was operated upon twelve hours later. Both herniæ were old inguinal, in both the sac was opened, and recovery took place. In the case of a Jewess æt. 30, I was called upon to see, with double femoral herniæ and an umbilical, I operated on this occasion upon the right femoral for strangulation, and a year later upon the umbilical with success.

Displaced Herniæ.

Displaced herniæ.

No cases demand closer attention than these. When understood and appreciated they may be successfully treated, and when misunderstood they are sure to be overlooked. Hence it may be accepted as a fact, that a strangulated hernia with its sac may be bodily reduced within the abdominal ring and behind the abdominal parietes, the intestine being still held by the neck of the sac (Fig. 269). This form was first described by the French writers as "reduction en bloc," or "en masse," and by Mr. Luke in this country ('Med.-Chir. Trans.,' 1843). The majority of cases reputed to be of this nature are, however, probably caused by other lesions of the sac, and the credit of having made this out is due to Mr. Birkett, in an able paper read before the Med. Chir. Society in 1859. He describes three forms, though his observations apply only to inguinal hernia.

Causes leading to displaced hernia.

Varieties of displaced hernia.

It would appear, therefore, that there are four varieties of displaced hernia.

In the *first* the strangulated hernia with its sac may be bodily reduced within the abdominal ring and behind the abdominal parietes, but it is only to a femoral hernia that this accident can occur. It is the true "reduction en bloc," or "en masse," of the French writers and of Luke. Such cases are, however, rare. In November, 1871, I had this fact demonstrated to me in a case I was called to see by Mr. Berry of Pentouville. It was in a lady, æt 64, who was said to have been ruptured for years, and had worn a truss. When I saw her she had been vomiting for a week, and a tense femoral hernia existed. Under chloroform, I cut down upon the sac and divided the neck of the crural ring, and on attempting reduction of the sac's contents by gentle manipulation, to my surprise the sac with its contents suddenly disappeared into the abdomen. By a little abdominal pressure it was made to reappear, and it did so in the same sudden way. A second attempt at the taxis was followed by the same result, and renewed pressure upon the abdomen with a like reappearance. For the sake of fully satisfying myself and my medical friends of the nature of the case, I reduced the hernia *en masse* a third time, and then found some little difficulty in securing its reappearance. When I did so, I took hold of the sac with my forceps, carefully opened it, and exposed the bowel without letting the sac go; I then divided its neck by a herniotome and reduced the bowel, keeping the sac well down. On the second day, the bowels acted, but the patient subsequently died of a low form of peritonitis. In this case the whole process of reduction *en masse* was demonstrated most clearly, and it compelled me to ask the question whether the same result might not have taken place had I attempted its reduction by forcible taxis without operation, since the facility with which the sac passed up within the crural ring was something startling.

First form.

Reduction *en masse*.

Example of.

In Prep. 2503[30], Guy's Hosp. Museum, this accident may be seen. It was taken from a woman æt 58; and my friend Mr. Henry Morris showed a specimen illustrating this fact at the Pathological Society. *Vide* 'Trans.' for 1871.

In the *second* form the neck of the sac becomes detached by force from the internal abdominal ring, and pushed upwards beneath the abdominal walls, the intestine within the sac being strangulated by the orifice of the sac. This variety is illustrated by diagram 266, and still better in Figs. 279 and 279A, which I have copied from page 486 of the first vol. of the 'Medical Gazette,' published in 1828. The case formed the subject of a lecture by Sir Charles, then Mr. Bell. It occurred in a man, æt. 47, who had been the subject of a right scrotal hernia for twenty years, which had come down and become strangulated three days before, but had been reduced, or rather *made to disappear*. The symptoms, however, continued, and death followed. During the last twenty-four hours of the patient's life the hernia came down repeatedly during the day, and was each time reduced with great facility.

Second form.

Displaced neck of sac.

Sir C. Bell's case.

After death the hernia was found to be in the scrotum, strangulated and mortified (Fig. 279). On applying pressure to it "the intestine could very easily and effectually be pushed through the external abdominal ring, so as to be hid from sight. On looking to the inside, however, it was seen that the portion of gut had carried the neck of the sac before it into the abdominal cavity B, Fig. 279; and the duplicature of peritoneum which hung upon the inside of the neck of the sac being unfolded, had formed a new sac for the intestine in the inside of the

abdominal muscles. Thus the fold of intestine was pushed through the external ring, through the spermatic canal, and through that part which is described to be an internal ring (but of which no trace could be seen), and was reduced within the abdominal muscles but not within the abdominal cavity," the neck of the sac still grasping the included portion of gut (B, Fig. 279A). The hernia was also clearly of the congenital form, although it had not descended as far as the testicle.

The two drawings (Figs. 279 and 279A) and descriptions are given as originally described by Sir C. Bell.

This case I have described somewhat fully, as I believe it to be the

Fig. 279.

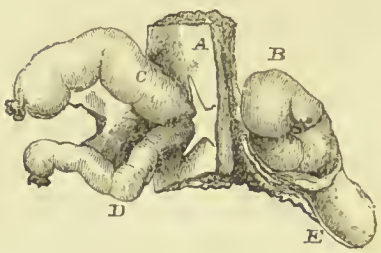
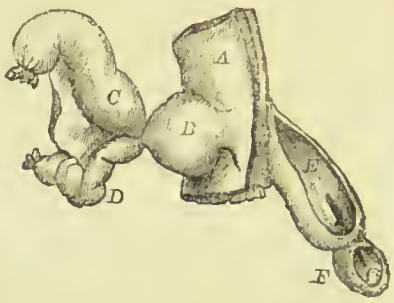


Fig. 279A.



Drawing illustrating the second varieties of displaced hernia.

Fig. 279.

A. A portion of the abdominal muscles, with the peritoneal lining.
B. The strangulated fold of intestine.
E. The testicle.

The dark lines at the neck of the sac represent the duplicature of the peritoneum, which being unfolded formed a sac for containing the intestine when reduced.

Fig. 279A.

A. Peritoneum lining the abdominal parietes.
B. The tumour formed when the strangulated intestine was pushed through the spermatic canal into the sac formed by peritoneum in the inside.
C. The superior portion of intestine.
D. The inferior.
E. The scrotal hernial sac.
F. The testicle, with the vaginal coat opened.

earliest on record in which this accident has been clearly made out. In it the neck of the sac had evidently been pushed upwards within the interual ring with the strangulated bowel.

Third form. Interstitial with ruptured sac.

In the *third* form (Fig. 267), "as the effect of forcible and long-sustained compression of the hernial tumour, the delicate serous membrane of the sac is rent, burst, or torn, and the hernia makes its escape through the aperture into the sub-serous connective tissue; its course outside the peritoneal sac is advanced by continued pressure; and detaching the connections of the neighbouring peritoneum, it forms for itself a pouch between that serous membrane and the interual abdominal fascia." —Birkett. The posterior part of the neck of an inguinal hernial sac is the usual seat of the rupture, and the position of the artificial sac is downwards and outwards. The "congenital" form of hernial sac is also the more liable to the accident (*vide* fig. 280).

Indications of a hernia having been displaced.

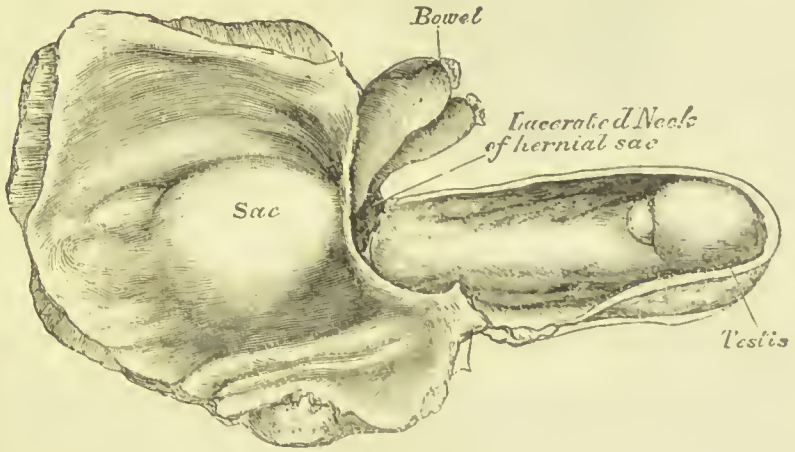
The indications of the accident having taken place are as follows: I give them in Birkett's words—"The tumour becomes flaccid, and, therefore, smaller; the bulk of the tumour slowly diminishes as the

pressure is continued, until at last very little, if anything, can be felt, but the *surgeon has failed to experience that sudden jerk so characteristic of the escape of the hernia* from the gripe of the month of the sac, as it enters the abdominal cavity. After the effects of the chloroform have passed away, *all the symptoms of strangulated bowel recur*, and, perhaps, with increased force. Even the tumour itself may reappear and recede on the application of slight pressure."

Mode of proceeding in such cases.

When this condition is found, there is but one form of practice to follow, and that is, the exploration of the sac. At its neck two orifices will be found, one dipping down into the artificial sac, and the second into the abdominal cavity; from the latter, the bowel will be seen to pass through the former into the artificial sac. The surgeon must then draw out the bowel from the sac through its false orifice, and having freely divided the true neck or abdominal orifice of the sac, replace the intestine, and "the exercise of great care and caution is needed to prevent the entrance of the hernia once more into the abnormal space outside the peritoneal cavity."—BIRKETT.

FIG. 280.



Third variety.
Interstitial hernia with ruptured neck of hernial sac.

Fourth form Interstitial with herniated neck of sac.

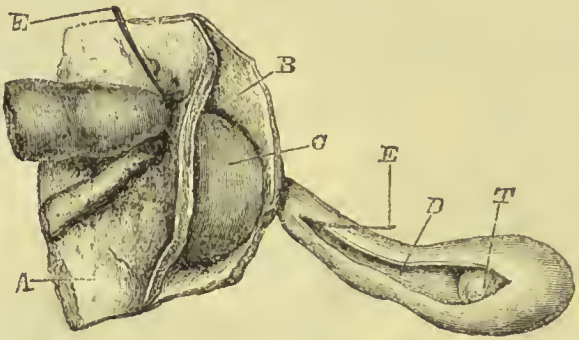
In the *fourth* form, an intermuscular, interstitial, or *intra-parietal* sac has also been described, being a kind of diverticulum from the inguinal sac, and is almost always found, according to Birkett, associated with the congenital form of hernia. This sac may be found in the anterior abdominal walls, in an upward, outward, or inward direction, mostly behind the abdominal muscles in front of the abdominal fascia, though in some instances in front of the external obliqne muscle beneath the skin. Birkett refers to a case recorded by Scarpa, and to a second by Dr. Fano. In some cases, the sac extends to the iliac fossa and rests upon the iliacus muscle, between the internal abdominal fascia and peritoneum; or directing itself inwards, it passes behind the horizontal ramus of the pubes and reaches the side and front of the urinary bladder (Birkett). Diagram 268 illustrates this form of hernia, but Fig. 281 does so much more clearly. It was taken from a preparation now in Guy's Museum, which was removed from a man, æt. 36, upon

Case.

whom I operated on September 23rd, 1869, for strangulated hernia. The man had been ruptured for fifteen years, and had worn a truss. The hernia had descended two days before his admission into Guy's, but the man had pushed it up by manipulation after a little trouble, though it did not go up as usual with a rush. After its reduction, vomiting appeared and local pain, and in this condition he was admitted into the hospital.

When I saw him all the symptoms of strangulation were present. No hernia was down, but there was some fulness at the internal ring, and above this towards the crest of the ilium, a tense globular swelling could be felt. This swelling I explored, and having laid open the inguinal canal I exposed the empty hernial sac (D, Fig. 281), with the testicle, showing that the hernia was of the congenital form.

Fig. 281.



Drawing illustrating the fourth variety or intra-parietal form of displaced hernia.

A. Peritoneum lining the abdominal muscles (B).
C. Intra-parietal sac with strangulated bowel.
D. Scrotal hernial sac leading down to testicle (T).
E. Director passed from the congenital scrotal sac through the internal ring.

In the drawing the strangulated bowel has been introduced to make the description clearer.

I then passed my finger into the internal ring and came against a knuckle of tense distended intestine. I enlarged the opening and this intestine at once protruded which was of a dark colour but still glistening. In following up this intention my finger passed downwards and outwards into a distinct cavity (C, Fig. 281), filled with bowel, but which was not the abdominal cavity. It was a distinct sac, with a smooth surface, and about the size of an egg. At its upper surface, it communicated with the hernial sac, and above this, with the abdominal cavity. I then increased the orifice leading into the abdominal cavity, drew out the strangulated bowel from the intra-parietal sac (C, Fig. 281) and returned it into the abdomen. The sac was clearly placed below the internal ring and between the abdominal muscles and peritoneum. The man died from peritonitis on the fourth day, his death allowing me to take the very excellent preparation from which Fig. 281 has been taken. The case was clearly one belonging to Mr. Birkett's third form or my fourth, an intra-parietal sac (Fig. 281, C) existing below the internal ring.

The disappearance of the tumour without the characteristic jerk and the persistence of the symptoms indicate all these forms. The treatment in all is the same as that described in the *third* form.

Prognosis of strangulated hernia.

Prognosis.—As the danger of a strangulated hernia depends upon the amount of damage the intestine has sustained by the strangulation, so the amount of damage the bowel has received is to be measured by the intensity of the strangulation and the length of its duration. A tight unyielding strangulation, such as usually exists in a femoral or in a direct inguinal hernia, does more harm in a short period than a less tight and more yielding constricting force, such as is met with in oblique inguinal hernia, in a longer period; violent taxis adding materially to the danger of the case.

The existence of peritonitis before the reduction of the hernia is always an unfavourable sign, as it is not likely to be lessened by the introduction into the peritoneal cavity of a portion of bowel already inflamed and altered in character. A hernia in an otherwise healthy subject, that has not been strangulated for many hours, that has not been injured by violent manipulation, and has been reduced by the "minor" operation, will probably do well, when another that has been strangulated for days, or been subjected to violent taxis, will probably do badly.

When kidney diseases exist.

Where disease of the kidneys or of other viscera exists the prognosis is always unfavourable, and, in old people, the same opinion must be formed.

A case in which the intestine has been freely exposed is more unfavourable than one in which no exposure has taken place, and any excessive manipulation of the hernial contents always adds to the danger.

The reduction of a severely damaged intestine is more liable to be followed by a bad result than where little injury exists, but a slightly injured bowel in an aged or unhealthy subject is always likely to do badly.

A recent hernia requiring operation is always far more fatal than an "old case."

Early reduction important.

In private practice, where herniæ, as a rule, are discovered and treated early, good success follows herniotomy, but in hospital practice, where neglect and delay combined have had their influence, treatment is very unsuccessful, nearly one half of the cases dying. At Guy's Hospital the average period of strangulation for femoral hernia is seventy-six hours; of inguinal, fifty; and half the cases that die after the operation do so within forty-eight hours, the injury to the bowel being so great and the power of the patient so reduced, that any reaction after the reduction of the hernia is rendered impossible. Under these circumstances, the worst that can be said for the operation is, that it fails to cure.

Inguinal Hernia.

On inguinal hernia.

Inguinal hernia, or that form which protrudes through the internal or external abdominal rings, includes two thirds of all cases of hernia, and about half of all cases of strangulated hernia. Two out of three cases of strangulated inguinal hernia are reducible by the taxis, the third requiring operation. In hospital practice, half of those operated upon die; operations in recent cases being most fatal.

Oblique and direct distinctions.

An inguinal hernia is called *oblique* when it passes through the internal ring and along the inguinal canal downwards towards the scrotum; *direct*, when it does not pass through the internal ring, but through the external in a direct way.

The oblique, from being anatomically placed external to the deep epigastric artery, is called *external oblique*, while the direct from being internal to the same vessel is known as the *internal direct.*

When the oblique has not passed the external ring, it is known as a *bubonocele;* when the oblique or direct has passed into the scrotum it is called a "*scrotal hernia*" or "*oscheocele.*"

In the *oblique inguinal*, the sac of the hernia may be the natural "vaginal process of peritoneum" that was formed on the descent of the testicle in fœtal life, and has not closed, *i.e.* "*a congenital sac*" (Figs. 261, 262, 263); or an *acquired sac* formed by the gradual pouching of the parietal peritoneum through the ring (Fig. 265).

In the *direct inguinal*, the sac is always of the acquired form.

Anatomy of vaginal tubular process of peritoneum.

This "vaginal tubular process of peritoneum" which communicates above at the internal abdominal ring with the peritoneal cavity, and below is in close contact with and adherent to the testicle, lies in front of the spermatic cord, and before birth, or soon after, "it contracts near the head of the epididymis, its surfaces adhere firmly at that spot, and thus two cavities are formed." The inferior one forms the permanent covering to the testis, and is known as the tunica vaginalis propria testis. The superior canal, when no arrest of development takes place, subsequently contracts—commencing at the internal ring, and creeping up till the canal ceases to exist.

Varieties in the closure of the tubular process.

When an arrest of development occurs and the abdominal orifice of the tubular process remains patent, a piece of intestine may at any time descend. *When the whole length* of the canal is open, the hernia will pass down *at once* into the scrotum to the testicle masking its presence, and in this way the "*congenital hernia*" of Haller, the "*hernia of infancy*" of Malgaigne, or the "*hernia into the vaginal process of peritoneum*" of Birkett, is formed (Fig. 261).

When the closure of the canal takes place higher up (and such an event is possible at any point from the testicle upwards) the descent of the hernia will be limited, though its nature is the same, the only difference being, that in this condition the testicle will be found below the hernial sac at a variable distance and separated from it. To this form of rupture, Birkett has given the name of "*hernia into the funicular portion of the vaginal process of the peritoneum*" (Fig. 262).

Congenital form of hernia in adult life.

It should also be mentioned, that it is not uncommon for this tubular vaginal process to close at its abdominal orifice at the internal ring, and yet remain more or less open as a cavity below; and, under these circumstances, any *sudden rupture or giving way* of the closing medium will be followed by the rapid formation of a hernia, the hernia being scrotal wholly or in part, lying upon or separated from the testicle, according to the absence or position of any point of closure. This form of hernia differs only in the sudden giving way of the abdominal orifice of the vaginal process from those last described, and is very common in young adults.

Congenital form of hernia.

To all those forms of hernia in which the sac is composed of the natural tubular vaginal process of peritoneum, the term "*congenital form*" of hernia would probably be the best, as indicating their nature, distinguishing them from the other form rightly called the "*acquired.*"

This congenital form of hernia is also frequently associated with some malposition of the testicle, such as its non-descent or partial descent.

Encysted hernia of tunica vaginalis.

The "*infantile hernia*" of Hey, or the "*encysted hernia of the tunica vaginalis*" of Sir A. Cooper, is an acquired hernia, the hernia *gradually pushing* the tissues closing the orifice of the vaginal process of peritoneum downwards into the open canal, the protruded parts together with the sac being contained in the tunica vaginalis testis, and the true sac being within that which might have been the congenital (Fig. 264).

Hour-glass contraction of scrotal hernia.

The hour-glass contraction of a scrotal hernia is always found in the "congenital form," and is due, as described by Birkett, to the imperfect closure of the vaginal sheath above the testicles, where union of its walls normally takes place. Prep. 2368 in Guy's Museum will explain these cases, also Fig. 263.

The acquired form of inguinal hernia a slow act.

The acquired form of inguinal hernia, oblique or direct, is *always slow* in its formation, the pushing downward of the parietal layer of peritoneum by the protruding viscera being a gradual process, thus forming a marked contrast with the congenital form. In the oblique, it begins as a slight yielding at the internal ring, and, in the direct, at the external, this yielding passing into a "pouching," till at last the pouch may reach and even fill the scrotum. In the early stage, this yielding may be scarcely perceptible, but to the patient it will give rise to a feeling of weakness and often of pain on any abdominal muscular exertion being made. When a "pouching," or according to Malgaigne, a "pointing" of the hernia has commenced, any act of coughing or straining will make it visible.

Bubonocele.

When the *oblique* hernia has filled the inguinal canal, it will appear as an ovoid swelling *above* Poupart's ligament (*vide* Fig. 270), beneath the tendon of the external oblique muscle. When it has passed through the external ring, the long axis of the tumour, and more particularly its neck, will still be in the inguinal canal above and parallel with Poupart's ligament; but, having escaped from beneath the external oblique muscle, it will appear as a pyriform scrotal tumour of variable size. The testicle will always be found below and distinct from the sac, the cord being behind the tumour.

Direct inguinal.

In the *direct* inguinal form in which the pouching of the hernial sac is directly behind the external ring (Fig. 271), there will be no inguinal neck such as exists in the oblique, the hernia passing directly through the external ring down into the scrotum. This form of hernia has thus a more globular shape than the oblique.

Diagnosis between oblique and direct hernia.

When the *oblique* inguinal is reduced, the surgeon can pass his finger through the external ring along the inguinal canal upwards and outwards into the internal ring, and thus into the abdominal cavity, although in old herniæ, the two rings are brought closer in apposition than in the more recent. In *direct* inguinal, the finger having passed the external ring, seems to enter at once into the abdominal cavity, the opening being directly behind the external ring, and, with the finger passed through the neck, the external border of the rectus muscle may be felt on the pubic bones. By these points the *diagnosis* between the acquired oblique and the direct inguinal can be made out.

Difference between congenital and acquired forms of oblique inguinal.

With respect to the points of difference between the "congenital" and "acquired" form of oblique inguinal hernia, a few words are needed, and may be thus epitomised. The congenital form is *the* hernia of infancy and young adult life, the "acquired" that of middle life and

old age. A hernia that has formed *suddenly, and passed at once* into the scrotum, is probably of the "congenital;" whereas one that has been produced slowly is more likely to be of the "acquired" form. When the hernial tumour envelops the testicle and renders its detection impossible or difficult, the "congenital form" is indicated. When the testicle is in its right place and distinct from the hernial sac, the "acquired."

A hernia with a long tubular neck occupying the inguinal canal is probably of the "congenital" kind, a short thick neck being more common in the "acquired."

The youth of the patient, the rapidity of its formation, and its close connection with the testicle, are the three chief points characteristic of the "congenital" form of hernia. The age of the patient, the slowness of its production, and its distinct separation from the testicle, the three points indicative of the "acquired."

Diagnosis of inguinal hernia.

The diagnosis of an inguinal hernia from other tumours is only difficult in exceptional cases. No scrotal tumour beginning in the scrotum and developing upwards can be a hernia, for all herniæ descend towards the scrotum. So, when a distinct separation exists between the scrotal tumour and the external ring no difficulty in diagnosis ought to be experienced. In this way ordinary hydroceles, hæmatoceles, and all diseases of the testicle are excluded.

Hydrocele and its varieties.

When a *hydrocele*, however, passes through the external up to the internal ring, a condition by no means uncommon in infancy and young adult life when the vaginal process of peritoneum is only closed at its abdominal orifice, some difficulty may be experienced; but in the absence of all symptoms of hernia, the translucency of the tumour, and the history of the case, viz. that the swelling began below and travelled upwards, are sufficient to point out the nature of the affection.

Congenital hydroceles into the vaginal process are to be distinguished from congenital hernia by their transparency, by the gradual filling of the sac, and by their vibration on percussion, whereas a hernia is opaque, enters the sac rapidly, leaves it quickly, and does not vibrate.

An *encysted hydrocele* of the cord appears as a tense, fluctuating, transparent, irreducible, tumour, and ought not to be confused with a bubonocele when no other symptoms of hernia exist beyond the swelling.

Varicocele.

The wormy feel of a *varicocele* or varicose spermatic veins, and the fact that pressure sufficient to keep any hernia in position with the patient erect over the external ring renders the varicose veins more marked, should prevent it being mistaken for a hernia. And if the surgeon would only look for the two testicles in every case of scrotal or even inguinal swelling, he could not fall into the error of mistaking an undescended testicle, or one resting at the internal ring or in the inguinal canal, for a hernia or any other disease.

Undescended testicle.

Hernia and hydrocele combined.

When a hernia and hydrocele coexist, some difficulty may be experienced in the diagnosis; but, as each affection has its own symptoms, the diagnosis ought not to be very difficult.

Whenever a doubt in diagnosis is felt about an inguinal tumour and symptoms of a strangulated hernia are present, the golden rule in surgery should be observed, and the doubtful tumour explored.

I had an interesting case (Feb., 1872) with the Messrs. Toulmin of Clapton, illustrating this, in a boy, æt. 4, who had an acute hydrocele associated with a sudden descent of a hernia into the vaginal process of the peritoneum of the cord. I tapped the hydrocele and left

the inguinal tumour, thinking it might be possibly a hydrocele of the cord, as no symptoms of strangulated bowel were present. These, however, soon appeared, and chloroform was given with a view of exploring the tumour, when, by the taxis, the hernia was happily reduced and the boy recovered.

Inguinal hernia in female.

Inguinal hernia is very common in the female child, indeed, under puberty, it is the usual kind, and is always of the "congenital form," the bowel coming down into the open canal of Nuck. It is found, however, at all periods of life, though as a direct hernia it is only seen in the adult. The rupture may consist of the ovary and descend into the labium. It can be recognised by the same symptoms as in the male, and should be treated on the same principles. A hydrocele of the cord may be mistaken for a hernia.

Treatment of inguinal hernia. When reducible.

TREATMENT.—A reducible inguinal hernia is to be kept up with a truss, whether in the infant, child, or adult; the truss too must be *well fitting*, exerting sufficient pressure to keep the hernia in position *but no more*. Should the hernia come down when the truss is on, it ought to be reduced, and the truss re-applied. The pressure of the pad in the oblique form should be over the *internal;* but in the direct, over the *external ring*. In infants, a complete cure is often obtainable by these means in a year or so, and if no descent or any other symptom of hernia shows itself for another year, the truss may be left off. In cases of hernia occurring after infancy, it is, however, never safe to leave off a truss. When some malposition of the testis complicates a case of the congenital form of hernia, care must be taken that the pad of the truss does not press the testicle, and, when the testicle and hernia are both in the inguinal canal, no truss can be tolerated.

Cure in infants.

Irreducible, inflamed, obstructed and strangulated inguinal herniæ are to be treated on the principles already stated.

When irreducible.

When a hernia cannot be kept up with a truss, but under no other circumstances, the question of the operation for the *radical cure* of the hernia may be entertained, as the operation has its dangers, and Wutzer, its early advocate, admits that a truss is necessary for life subsequently.

A strangulated *direct* inguinal hernia is, however, a far more serious affection than the *oblique*, the sharp unyielding edge of the ruptured tendon surrounding the neck of the sac acting as rapidly upon the strangulated bowel as does the edge of Gimbernat's ligament in femoral hernia.

The Radical Cure of a Hernia.

On the radical cure of hernia.

This has been the aim of surgeons from time immemorial; and, were hernia only a mechanical lesion due to a weakness of the walls through which it protrudes or of the neck of the sac, some success would probably have attended the practice; but as a rupture is more probably due to something more than this, it can hardly be expected that any very good result should have been obtained. Gerdy, Wutzer, Rothmund, Wells, and Davies, have all tried to accomplish this by plugging the mouth of the sac with its invaginated fundus, Gerdy fixing the invaginated fundus by means of two sutures; Wutzer by means of a cylindrical wooden plug passed into the inguinal canal in the hollow of the invaginated structures up to its neck, and a grooved wooden pad being applied externally over the first to hold the parts in position. The two wooden instru-

ments being held together by a needle (which is enclosed in the cylindrical part and made to pass through the internal ring and external tissues) and a screw; the plug should be retained for six or seven days. Rothmund, Wells, Davies, and others, have only improved upon Wutzer's method. Mr. Birkett, however, tells us on the authority of Dr. Otto Weber, of Bonn, the late clinical assistant to Wutzer, that Wutzer is still of opinion that his operation is not dangerous when properly performed, and that by his method, the fundus of the invaginated sac may be made to adhere to its neck, and as a consequence of this, *if the patient continue to wear a truss for life, a return of the hernia may be avoided.*

Weber's statement as to its inefficiency.

Dr. O. Weber, however, writes that he has never seen any of the so-called "cured cases" radically cured; that the plug of skin is by degrees entirely drawn out again; that the external and internal rings are not closed by the operation; that an imperfect cure may be effected by means of a partial closure by adhesion of the internal walls of the neck of the sac and thickening of the surrounding tissues. In London practice, it is also well known, that a fatal peritonitis has followed the attempt. With these facts before us respecting the so-called cure by invagination, and the knowledge that even when the cure has been effected the wearing of a truss is still an essential point of practice, the operation may be dismissed as one that cannot be recommended.

Mr. Wood, of King's College, believing that Wutzer's principle of practice was as wrong as his practice was unsuccessful, devised in 1863 an operation, by which the hernial sac, without the skin, is invaginated into the canal, and the hinder and inner walls of the inguinal canal are drawn forward by means of sutures, and fixed to the anterior and outer walls.

The steps of the operation are conducted as follows. They are taken from Druitt's 'Vade Mecum,' as revised by Wood:—

Mode of performing the radical cure.

The patient being laid on his back, with the shoulders well raised, and the knees bent, the pubes cleanly shaved, the rupture completely reduced, and chloroform administered, an oblique incision, about an inch long, is made in the skin of the scrotum over the fundus of the hernial sac. A small tenotomy knife is then carried flatwise under the margins of the incision, so as so separate the skin from the deeper coverings of the sac, to the extent of about an inch, or rather more, all round. The forefinger is then passed into the wound, and the detached fascia and fundus of the sac invaginated into the canal. The finger then feels for the lower border of the internal oblique muscle, lifting it forwards to the surface. By this means the outer edge of the conjoined tendon is felt to the inner side of the finger. A stout semicircular needle, mounted in a strong handle with a point flattened antero-posteriorly, and with an eye in its point, is then carried carefully up to the point of the finger along its inner side, and made to transfix the conjoined tendon, and also the inner pillar of the external ring. When the point is seen to raise the skin, the latter is drawn over towards the median line, and the needle made to pierce it as far outward as possible. A piece of stout copper wire, silvered, about two feet long, is then hooked into the eye of the needle, drawn back with it into the scrotum, and then detached. The finger is next placed behind the outer pillar of the ring, and made to raise that and Poupart's ligament as much as possible from the deeper structures. The needle

is then passed along the outer side of the finger and pushed through Ponpart's ligament, a little below the deep hernial opening (internal ring). The point is then directed through the same skin puncture before made, the other end of the wire hooked on to it, drawn back into the scrotal puncture, as before, and then detached. Next, the sac at the scrotal incision is pinched up between the finger and thumb, and the cord slipped back from it, as in taking up varicose veins. The needle is then passed across behind the sac entering and emerging at the opposite ends of the scrotal incision. (Fig. 282.) The end of the inner wire is again hooked on, and drawn back across the sac. Both ends of the wire are then drawn down until the loop is near the surface of the groin above, and are twisted together down into the incision, and cut off to a convenient length. Traction is then made upon the loop. This invaginates the sac and scrotal fascia well up into the hernial canal. The loop of wire is finally twisted down close into the upper puncture, and bent down to be joined to the two ends in a bow or arch, under which is placed a stout pad of lint. The whole is held steady by a spica bandage. (Fig. 278.) The wire is kept in from ten to fourteen days, or even longer, if the amount of consolidation is not satisfactory. Very little suppuration usually follows, but after a few days the parts can be felt thickened by adhesive deposit. The wire becomes loosened by ulceration in its track, until it can be untwisted and withdrawn *upwards*. In this operation the hernial canal is closed along its whole length, and an extended adherent surface is obtained to resist future protrusion.

Fig. 282.



From Wood.

Treatment after the operation.

After the operation, Wood says, a horse-shoe pad should be worn for a few months *and the truss is not to be thrown aside when the patient is about to be subjected to violent strains or lifting*. This is important to remember though it tends much to do away with the value of the operation.

Modifications of the operation are employed for infants, &c.

Wood's statistics of the operation.

The ingenuity of this operation is great, and *where the radical cure is called for* should be employed. Wood says ('Lancet,' August, 1873) he has operated 200 times with three deaths, and out of 107 cases in which the results were more or less perfectly known, in 51 a return of the hernia took place, of which 42 returned within the year; in 56 a satisfactory result was secured. Thus, in the most favorable light, there is one failure to one success, and risk to life. It is to be feared, however, that a large number of these so-called satisfactory cures are only so when they leave the operator's hands, since Kingdon's Reports of the City of London Truss Society tell us, that within the last ten years, fifty persons who had undergone some operation for the

radical cure had, in consequence of its failure, applied for trusses; and this number is large, considering the surgeons who perform this operation are not numerous, nor the cases abundant.

When the operation is uncalled for.

For my own part, I believe, that where a hernia can be kept up by a truss, and the patient is likely to remain in a civilised country where trusses can be obtained, any operation for the radical cure is unjustifiable. To risk the life of a patient on the theory of a cure, when a truss, as a matter of safety, has to be worn subsequent to the operation, is both unfair and unsatisfactory.

When the operation may be justifiable.

When a hernia is reducible and cannot be kept in place by a truss; when a patient is going abroad where trusses are not to be obtained, or only obtained at too great a cost, the operation for the radical cure may be undertaken. Indeed, under these circumstances I have performed Wood's as well as Wutzer's operation with good success; that is, the patients who previously could not keep up their hernia on account of the great size of the inguinal ring were enabled to do so. Under all other circumstances, I have refused to undertake it.

In the "congenital form" of inguinal hernia, there seems a better prospect of success following the operation than in any other, and a better basis for the practice; for "thus allowing nature to guide our procedure, we must make it a rule to select those cases in which her efforts have failed; and by acting as her handmaid, we may reasonably hope to arrive at a successful result." (Birkett.)

Femoral Hernia.

On femoral hernia.

This forms about one tenth of the whole number of cases of hernia, and about forty per cent. of all cases of strangulated hernia; and is

More liable to strangulation.

also far more liable to become strangulated than inguinal, though less likely to be reduced by the taxis. The taxis, moreover, is more prone to produce injury. One out of three cases of strangulated femoral hernia is reducible by the taxis, two being operated upon and of these 40 out of every 100 die, the operation after "recent hernia" being twice as fatal as it is after the "old"—a strangulated femoral hernia going on more rapidly to destruction than any other, and a strangulated "recent" than an "old" hernia.

Anatomy of the hernia.

Femoral hernia descends from the abdominal cavity through the crural ring *inside* the femoral vessels. The free margin of Gimbernat's ligament bounds its inner side, and the sac which is always acquired, pouches downwards beneath Poupart's ligament and emerges through the saphenous opening to the inner side of the falciform process of the fascia lata. The hernia expands laterally, resting upon this fascia, and, as it enlarges, turns upwards over Poupart's ligament, then in the direction of the crest of the ilium, very rarely spreading

Position of hernia.

downwards. Its long diameter will be transverse and not vertical. The neck of the hernia will always lie *outside* the spine of the pubes or the tendon of the long adductor, while an inguino-scrotal or labial hernia

Situation of vessels.

will always be found *inside* these points. The deep epigastric artery and vein usually lie outside the neck of the sac, and are free from harm in the operation; though when the obturator comes off from the epigastric, and arches over the neck of the hernia to dip down on its inner side towards the obturator foramen, it may be divided when a *free* incision is made.

Rare cases of femoral hernia occur external to the femoral vessels, as related by Partridge (' Path. Soc.,' vol. i), as well as through Gimbernat's ligament, or with a diverticulum through the cribriform or superficial fascia. (*Vide* Birkett.)

Diagnosis of femoral hernia.

Diagnosis.—The points already stated will enable the student to distinguish a femoral from an inguinal hernia.

Psoas abscess.

A psoas abscess dilates on coughing, and disappears or diminishes on the patient lying down, just as does a hernia; but it is usually placed beneath and outside instead of inside the vessels. It is often accompanied also by spinal symptoms; and, on manipulation, gives the sign of fluctuation from above to below Poupart's ligament.

Varix.

A varix of the femoral vein may also in a measure simulate a hernia; but, whereas in a hernia, with the patient erect, pressure over the crural ring and vessels will prevent its descent, in varix it will cause its enlargement.

Enlarged gland.

An enlarged gland ought not to be mistaken for a rupture, as the history of the case and concomitant symptoms generally mark its nature.

Cysts.

Cysts in the crural ring are doubtless difficult to diagnose, although from their always being in the same spot under all circumstances, and from their not being influenced by position, coughing, &c., they are unlike hernia. When associated with a strangulated hernia they may complicate, but seldom lead to error.

Treatment of femoral hernia.

Treatment.—Reducible hernia can be treated by a truss, the pad pressing in the hollow below and external to the spinous process of the pubes. The radical cure has been performed by Wood, Wells, and Davies, but it cannot be recommended.

Strangulated femoral hernia requires the most prompt attention, for the parts constricting the neck of the sac are so unyielding as to produce in a short period an amount of damage which is too often irreparable. In the application of the taxis, the utmost gentleness should be employed, and the administration of chloroform should always precede the attempt. In the reduction of an old femoral hernia, the taxis rarely succeeds.

Caution with taxis.

Mode of using taxis.

In reducing a femoral hernia by the taxis, the surgeon should always remember the position of the orifice of the sac, for when it has turned over Poupart's ligament, any pressure on the tumour can only do harm. The tumour should be gently raised by the fingers, and drawn slightly downwards and to one side before pressure is applied, which must be of the mildest kind. If the slightest disposition to yield be shown, the pressure may be continued, because when any of the contents of the sac are emptied, the probabilities of the reduction of the whole are greatly enhanced. If no yielding be felt in the parts, the taxis had better be given up, and the operation performed.

On opening the sac.

In all operations for femoral hernia, the reduction of the hernia without opening the sac should be preferred, and, in "recent" hernia this "minor" operation is generally successful. The incision to expose the sac consequently should be a limited one. Luke suggested that "a fold of integuments is to be pinched up and divided by transfixing it with a narrow blade, so that the incision when the skin is replaced shall fall perpendicularly to the body, with its centre opposite to the depression, which indicates the seat of strangulation." But

this plan is, in a measure, dangerous, as I have seen Mr. Aston Key with the point of his knife divide all the tissues outside the sac and even the sac itself in perforating the skin-fold, and have known a less skilful surgeon open the bowel.

Gay's operation.

Mr. Gay advises "an incision rather more than an inch long to be made near the inner side of the neck of the tumour. The superficial fascia to be divided, and a director or *bistouri caché* introduced down to the neck of the tumour, and through the crural ring, by the least amount of force, and with the aid of a little gentle compression of the inner side of the tumour by the finger, the point of the bistoury may be insinuated between the sac, or rather fascia propria, and the pubic margin of the ring; the edge of the knife is then to be turned towards the pubes, and by projecting the blade the seat of stricture in that direction may be effectively divided." When a director is used or the finger, the ordinary hernia knife may be applied in the same way.

Nothing can be more satisfactory than this operation when reduction is effected by it, and it should always be attempted. It it fail, and the sac has to be opened, no harm can possibly have been caused by the proceeding, as the incision can readily be enlarged, if necessary, the sac opened, and its neck divided.

Remarks on strictures and difficulties met with in the operation.

Any modification of the incision, however, may be made. The essential point is, that the incision should be of such a nature as to allow the surgeon to reach with facility the neck of the tumour. In operating, the surgeon must also remember the fascia propria or fascia that is external and superficial to the sac, which will always appear as a well-defined sac on the division of the soft parts that cover it, and that may be mistaken for the true sac. On its division, a layer of fat will often be found more or less lobulated, which is the subperitoneal fat, and beneath it will be found the true peritoneal sac. In Gay's operation, as already described, when the parts outside the fascia propria have been divided, and the hernia cannot be reduced, there is no objection to the surgeon dividing the neck of the sac upon a director, and when this fails, the sac must be fully opened. The flow of a stream of serum will probably attend this step, and, as previously stated, the nature of the fluid will indicate the condition of the parts within. When intestine is alone seen, the director may be carefully introduced into the neck of the sac and the constricting orifice divided, the intestine being then reduced with the gentlest pressure. When omentum covers the bowel, it should be carefully raised and unravelled, and when an omental sac exists, it must be torn through or carefully divided and dealt with as previously explained. The neck of the sac should be divided outside the omentum. The less the parts at the neck of the sac are disturbed the better; no introduction of the finger beyond the neck of the sac being necessary, and no passing of the director or hernia knife called for beyond the neck. When the neck of the sac has been divided, and the sac has subsequently to be opened to ensure the reduction of its contents, it is seldom necessary to reintroduce the bistoury, the parts yielding enough to the finger to allow of the replacement of the hernial contents, for the less the neck of the sac is divided the better. The surgeon should always be careful that the hernia is not reduced within the crural ring, together with the sac; if so, the sac must be brought down again, opened, and held in *situ* whilst its contents

When an omental sac exists.

When sac opened.

are returned. The after-treatment of the case is to be based upon the principles which have been already laid down.

Obturator Hernia,

On obturator hernia.

or hernia through the foramen of that name, deserves a notice, as its successful treatment can only follow its diagnosis. It is more common in females than in males, and is often unattended by any external evidences of its existence. Birkett has collected twenty-five examples of this affection; though in fourteen the hernia was not discovered till after death. In three only was a successful operation performed: by Obré in 1851, Bransby Cooper in 1853, and Lorinson in 1857. Mr. Cooper's case I had the good fortune to see.

Its rarity.

The sac of the hernia is always "acquired." It emerges in the thigh beneath the pectineus and between the adductor longus and femoral vessels. The hernia is consequently on a lower level than the femoral, and comes forward instead of downward. An obturator hernia is not, however, always to be felt, and a diagnosis has consequently to be made out of the general symptoms; and of these, *pain in the course and distribution of the obturator nerve is the most marked.* It is not, however, always present. In several of the recorded cases, during the development of the hernia, the pain described as "spasmodic contraction of the abdominal muscles" existed, and this fact is explained by Birkett in recalling the association there is between this nerve and the muscular filaments distributed on the abdominal muscles, all being branches of the lumbar plexus. Birkett also observed that movement of the hip-joint in the affected side excites or aggravates the pain, so does deep local pressure, and pelvic examination, either per vaginam or rectum. In the following case, however, which came under my care in 1875, none of these symptoms were present, though a fixed pain in the left iliac fossa existed. Susan G—, æt. 65, a married woman, was admitted under my care into Guy's Hospital on the 26th May, 1875. She had enjoyed excellent health till 1871, when one morning, after considerable exertion, she experienced great pain in the left side, and was able to sit down only with difficulty. The medical man who saw her said that she had a hernia, but that it had gone up. Her health after this remained indifferent, though she was able to go about till six months before her admission, when she passed no motion for nine days and was very sick. Purgative draughts, however, acted upon the bowels very freely, and she convalesced. She then continued well until ten days before her admission. At that time no motion had passed for ten days, she had continually vomited, looked very unhealthy, much emaciated and yellowish, was cold and collapsed, the abdomen being somewhat distended, with visible coils of small intestine and peristalsis. She also complained of diffused abdominal pain. No growth could be detected in the rectum. Opium was administered, and warm fomentations applied to the abdomen with relief, and, after four days, the bowels acted twice spontaneously, and subsequently she had repeated loose evacuations. She left the hospital convalescent though much emaciated, on June 15th, 1875, nineteen days after her admission. She was, however, re-admitted on December 26th of the same year, having remained quite well till December 3rd, though for the last three months she had been in much reduced circumstances. On December 3rd she was again violently sick, and had much pain

The sac always an acquired one.

Diagnosis.

Case.

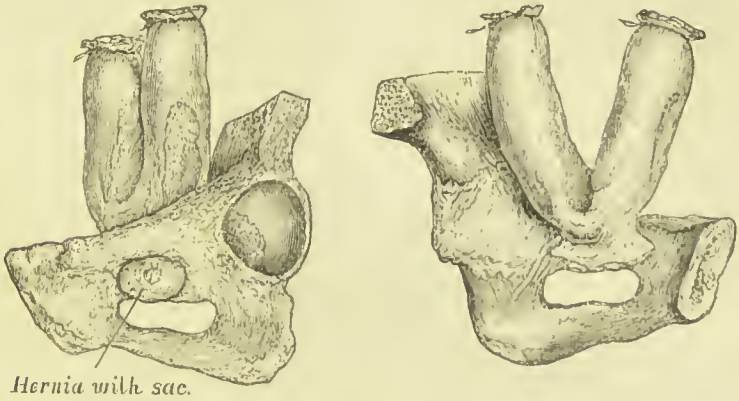
in the *left side* of the abdomen, which was increased on passing a motion. The bowels were confined and the fæces small. She had now a double femoral reducible rupture. Her abdomen was natural, and a rectal examination showed nothing abnormal. She was placed under the influence of opium, when the sickness ceased and the bowels acted. On January 6th, however, the symptoms returned. She was again sick, and had much pain in the left side of the abdomen, while the temperature rose to 101° F. From that time she gradually sank. The bowels were not again relieved, the abdomen became tympanitic, and the vomiting only ceased a few days before death, which took place on February 4th, with increasing exhaustion. She had at no time anything like obturator pain, and though all the regions of hernia were carefully examined, nothing was noticed to suggest the disease.

Autopsy. *Autopsy by Dr. Goodhart.*—The body was very emaciated; there was no marked distension of the abdomen; the peritoneum was injected all over. A little pus was smeared over the coils in the neighbourhood of the cæcum, and in the pelvis, two ounces of pus or more had gravitated to the bottom of Douglas's pouch. No evident source of the pus could be discovered, though it is probable that it arose from peritonitis, due to over-distension of the bowel. The small intestine was only moderately distended, but crammed with pultaceous, yellow, fæcal contents, and the coats were somewhat thickened. Following it downwards, the distension continued till two feet from the cæcum, where a piece of the bowel passed through the left obturator foramen. (Fig. 284.) Below this, the intestine was very contracted, The aperture in the obturator foramen was not large, and the intestine did not appear to be nipped in any way. A knuckle of bowel was in the sac, but the passage onward would not allow of the introduction of the little finger. The bowel was intimately adherent to the sac throughout, so that on opening the latter the bowel was wounded. The included bowel was greyish, but neither gangrenous nor inflamed. The mesentery was somewhat thickened at its neck, and within the bowel were some old ulcerations, as judged from the amount of thickening of the edges of an ulcer found at the neck of the hernia. The ulceration, however, was not within the neck, but rather on the opposite uninclnded surface of the intestine. The sac pushed the obturator nerve and vessels well to the outer side and to its upper part, with the exception of one branch of artery, which passed to the thigh on the inner side.

The obturator muscle, which was in front of the sac, had to be scraped away to get at it. The sac was of nodular shape, and about two thirds of an inch in diameter. (Fig. 283.) It caused no fulness externally on the thigh. This was looked for particularly, because the protrusion was first discovered from the inside. In addition to the hernia, another coil of bowel (small intestine considerably higher up) was adherent by a strong band at the hernial neck, and about this the distended coils had twisted in a peculiar and indescribable manner, yet no obstruction had resulted therefrom, the distension continuing both above and below it. A slight femoral protrusion also existed on both sides. On the right side, a little omentum was adherent at the neck of the sac, and, by its adhesion, dragged down the pyloric orifice of the stomach and the textures in the portal fissure.

Death, in this case, was clearly due to chronic intestinal obstruction, caused by the adhesions of the bowel to the hernial sac. The only

Fig. 283. Fig. 284.



External view. Internal view.

Obturator hernia.

special symptom worthy of notice was, the fixed pain in the left side of the abdomen above Poupart's ligament.

Treatment of obturator hernia.

Treatment.—The taxis can hardly be expected to be a successful proceeding in obturator hernia, the sac being so low down in the thigh and so little under control. Nevertheless, it should be tried, with the adductors relaxed, by means of steady pressure applied downwards in the hollow of the thigh, and inwards between the adductors.

Operation for obturator hernia.

To explore the parts, an incision should be made below Poupart's ligament, and to the inner side of the femoral vein, down to the pectineus muscle, which may then be divided. If no sac appear, and the obturator foramen covered by its muscle be reached, the fibres of this muscle must then be separated and the obturator canal found; for a small hernia, as proved by the case I have recorded, may be well hidden by the muscle. When a sac is felt, the parts constricting it must be divided by a knife and its contents reduced. The obturator nerve, if possible, should be avoided.

Umbilical Hernia.

On umbilical hernia.

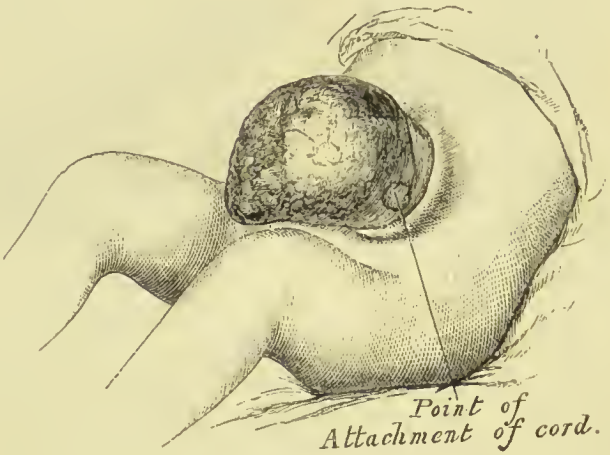
This may be a congenital or acquired affection, and is common in children from want of closure of the umbilicus. It is far from rare in fat women, and others who have had many children. It is also met with in men, forming 5 per cent. of all cases of hernia, and 6 per cent. of cases of strangulated hernia.

Congenital umbilical hernia.

The congenital form.—Children are occasionally born with a hernial protrusion of some of the abdominal viscera into the umbilical cord, the covering of the viscera consisting of the thin translucent sheath of the cord; this deformity is probably due to an arrest of development. Among the few examples of this affection that I have seen was one in which the liver projected, and in it the serous covering sub-

sequently granulated, contracted, and so pressed the parts back into their normal position that a recovery followed. Fig. 285 represents the case in the fifth month. In the case of a male child, one day old, in which a hernia into the cord the size of a small egg existed, and through the thin walls of which the cæcum with its appendix was clearly visible, I pressed the bowel back with my finger and thumb,

Fig. 285.



Congenital umbilical hernia.

stitched up the cord at its umbilical orifice with some deep sutures, and ligatured the cord itself at the apex of the congenital translucent hernial sac, and complete recovery followed without any bad symptoms. The child was alive and well two years after the operation. The case was brought to me on June 16th, 1876, by an old dresser, Dr. W. Cock, of Peckham. The practice adopted in the case is that which I advise to be followed.

The acquired form.

In the acquired form of hernia, the *sac* is always formed, both in the infant and adult, by the pushing forwards of the parietal abdominal layer of peritoneum. The parts covering it being occasionally very thin, are only integument and fascia, the internal abdominal fascia being over the true sac; at times the tumour attains a large size, and, as it generally increases *downwards*, the surgeon must look for the neck of the sac at its upper part. These herniæ at times assume odd shapes.

Treatment of umbilical hernia.

Umbilical truss.

Treatment.—When in an infant and reducible, a cure may with some confidence be promised; indeed, with the majority of cases in young life an opening in the navel will contract, if care be observed to fix over the part with good strapping a *flat* elastic ring or pad covered with leather. A convex pad tends to keep the ring open. A belt or truss in early life is a delusion since it never keeps its place. In lieu of a pad, it is an excellent plan to pinch up the integument over the hernia with the thumb and finger and then to turn the folds sideways upon the umbilical opening, fixing it in its position by waterproof strapping, the folded integument by this method acting as a pad and assisting recovery.

Messrs. Lee, Barwell, and Wood have suggested an operation for the closure of the umbilical orifice, but such a measure cannot be recommended; since to risk life unnecessarily for an affection that is mostly curable by time and natural processes assisted by art, is hardly justifiable.

Adult patients with reducible ventral hernia should also wear some mechanical appliance, such as a ring truss; and an irreducible rupture should be protected by a cup truss.

When large and irreducible. When obstructed.

When these tumours are large and irreducible, they give rise to troublesome abdominal symptoms. They supply, indeed, the best examples seen of so-called obstructed hernia; fæces and flatus entering the incarcerated intestine and remain immoveable, causing nausea, colicky pains, and constipation. Rest in the horizontal position, the local application of ice, a good enema to empty the lower bowel, and a purge to clear out the upper, will often, under these circumstances, prove of great benefit; and should be tried in all cases.

When strangulated.

When symptoms of strangulation exist, such measures, however, must not be thought of. The taxis should then be employed, and with a patient under chloroform, as a rule, it proves successful. In applying it to a large tumour where it is probable a fresh descent of intestine has taken place, and the symptoms are due to its strangulation, the surgeon should examine the tumour carefully to discover if one part is more tense than another; as then the taxis should be applied to the tense part in preference to the other. On several occasions, by adopting this practice, I have been able to reduce with complete success the strangulated portion of the contents of a hernia. When vomiting, constipation, local pain, and an absence of impulse in the tumour are persistent, the reduction or freedom of the mass from strangulation by operation must be entertained.

Taxis under chloroform.

Operation for umbilical hernia.

When herniotomy is called for, it is a matter of immense importance that no manipulation of the contents of the sac should take place, because when the sac is opened and the parts exposed, it is an exceptional occurrence for a cure to follow, no cases of hernia under these circumstances being more fatal than the umbilical. When the sac is not opened, however, so as to expose its contents, or only opened at its neck to allow of the division of the strangulating orifice, a good result may be expected.

Not opening sac.

In many cases in which I have adopted this practice a good result followed, the oldest patient being seventy-four years of age, with strangulation of five days' standing.

When neck of sac only to be divided.

In irreducible hernia of large size and of long standing, when reduction of the contents of the sac, as a whole, cannot be expected, and there is no evidence of strangulation within the sac by some of its contents, the surgeon should be satisfied with relieving the strangulation by dividing the neck of the sac, and leaving the case to nature. To explore the whole sac, and to expose the irreducible bowel to the air and manipulation, is an unnecessary as well as fatal practice. I had a case in 1874 with Mr. Brockwell, of Sydenham, in which, in a lady, an irreducible hernia of seven years' standing became strangulated, when I simply divided the neck of the sack and left the parts alone. After two days the whole contents of the sac returned, and a rapid and complete recovery took place. I have followed this practice on several

When a double sac exists.

occasions with a similar result. A *double sac* is found at times in umbilical hernia. Some time ago I was called on to operate in such a case. The woman was aged 44, and had been ruptured for years, the hernia being irreducible. She came under my care at Guy's, with symptoms of two days' strangulation. The rupture was clearly inflamed, the slightest manipulation causing intolerable pain. Under chloroform I cut down upon the tumour, and found two distinct sacs, their orifices which were placed laterally, being separated by a piece of dense fibre tissue. One contained a mass of omentum, the second, intestine, which was black from congestion and covered with lymph. The orifices of the sacs were freely divided and their contents left, but the patient died, and no examination after death was allowed. In another case, I found strangulated bowel in a small omental sac introduced into an irreducible hernia.

On ventral hernia.

A ventral hernia is a term applied to any protrusion through the abdominal walls not belonging to the usual forms. Most of these are found in the linea alba above the naval. One of the largest I ever saw was over the right iliac fossa; and followed a rupture of the abdominal muscles caused by a fall of twenty feet upon the handle of a pump. It was the size of a man's hand, and strangulated. By the taxis I reduced the mass, and, by the use of ice locally and opium internally, the man recovered. He had, however, subsequently to wear a pad to support the part.

After the operation of ovariotomy a very large protrusion may take place, if a good belt be not worn. The same may arise after the weakening of the abdominal walls from abscess.

When the hernia takes place below the xiphoid cartilage it is called *epigastric*, and in the loins, *lumbar*. Birkett quotes two such cases. In 1875 I saw an example of the epigastric form with Mr. Treves, of Margate, in a lady, æt. 68, who had at the same time an irreducible umbilical hernia. Symptoms had existed for 108 hours when I operated, and the bowel slipped back unseen on dividing the parts at the neck of the sac. The patient, however, sank.

On perineal hernia.

Perineal hernia descends in front of the rectum and appears in the perinæum, and is most common in women. When the hernia descends outside the vagina along the ramus of the ischium, it shows itself in the labium, *labial* or *pudendal hernia*, and when it appears in the vagina, *vaginal hernia*.

Vaginal and labial herniæ may be mistaken for the mucous cysts of those parts; but the herniæ are reducible, and, when irreducible or strangulated, they give rise to symptoms indicative of these conditions. The cysts are only local affections, and cause no general symptoms. They are tense, elastic, globular tumours, fixed in the tissues, and have *no neck* passing upwards into the pelvis.

On ischiatic hernia.

Ischiatic hernia is a hernia through the sciatic notch, above or below the pyriformis muscle. The glutens maximus muscle covers it in; but, as the hernia enlarges, it may appear below the lower border of that muscle. Dr. F. C. Crosse, in Sept., 1873 ('Dublin Journal of Medical Science'), has recorded an interesting example of this kind in a woman, æt. 40. The tumour occupied the lower border of the right gluteal fold, it was the size of a fœtal head, soft and pulpy to the touch, dull in parts, tympanitic in others; and coughing gave an impulse to it. It was treated by a truss. When such a rupture becomes stran-

gulated an operation must be performed, the surgeon making such an incision as will best expose the tumour and its neck.

On diaphragmatic hernia.

Diaphragmatic hernia is met with as the result of an accident (traumatic), and is generally fatal; it has been alluded to under the heading of "Abdominal Injuries," page 607. It may also be the result of some "congenital" defect, or the pushing of the abdominal viscera through a natural or other opening in the muscle (acquired form). It rarely calls for surgical aid.

On Trusses.

Description of truss as to use.

A truss is an instrument employed for the purpose of preventing the descent of a hernia. It is composed of a pad, to be placed over the seat of the hernial protrusion, and a spring or belt to keep it in position. Any truss that will keep up the hernia under all circumstances, and does not cause pain or lasting discomfort, is probably beneficial. Every truss that fails to carry out this object should be condemned. An instrument with a too feeble spring is a delusion and snare; but one that is too powerful may tend to do more eventual harm than present good by causing absorption of the abdominal parietes upon which it presses, and, as a consequence, enlargement of the opening through which the hernia descends. For the same reason a pad that is unduly convex is also to be condemned.

A truss that will keep up one hernia may fail in the case of another. Every hernia, in fact, requires a special adaptation of the pad as well as a carefully regulated spring.

When to be worn.

Every subject of a hernia, young or old, male or female, should wear a truss, and, in a good proportion of cases, particularly of the young, a cure may take place; that is, the neck of the sac may close. But even after a cure, or apparent cure has taken place, it is well, for the sake of safety, to wear the instrument; as cases are far from infrequent, when a supposed cure had taken place, and after the lapse of years, a sudden descent has occurred, jeopardising life. This is the more common in the congenital form of hernia.

The truss should be worn all day, from the act of rising out of bed to that of retiring, as its object is to prevent the descent of the hernia under any sudden act of exertion, and, with the truss off, it is impossible to guarantee that any such may not be made. Some patients have a habit of removing their trusses when they are sitting in their drawing-room, but this is to be condemned, since I have more than once been called upon to treat a strangulated hernia which came down under these circumstances, during some unguarded act; and it is in these unguarded moments that the truss is calculated to be of so much benefit.

When the truss is first applied, it will doubtless cause inconvenience, which will soon pass away. The use of plenty of starch or violet powder, the bathing of the point of pressure with some spirit and water, and attention to keep it very dry, are excellent remedies for any little local source of discomfort.

On the pad of a truss.

The pad.—This should be regulated according to the size of the hernial aperture. A small opening requiring a small pad, and a large opening, a large one. The pad should always overlap for about half an inch all round the hernial aperture, and in large herniæ, for more. It should be slightly convex when made of any yielding material; and

flat, when of a firmer consistency. It should also be so adapted to its spring as to keep its place under all circumstanees.

In inguinal hernia. In inguinal hernia it should, moreover, be so fixed to the spring as to exert a pressure at right angles to the plane of the hernial aperture. Thus, in large pendulous bellies, the pressure may be upwards, or in-

In femoral. wards and upwards; but in thin subjeets directly baekwards. In femoral rupture, the pressure should always be backwards, in order to elose the erural ring. Any truss that applies its pressure only in one direction must fail in its purpose in a large number of eases. It is, indeed, in this eurve of the spring, or direetion in whieh the pressure of the pad is employed, that the ehief differenee in the great varieties of trusses is found.

Some pads are rigidly attaehed to the spring that holds them in position, while others are eonneeted by means of movable joints of different eonstruetion. Salmon and Ody's well-known truss has a ball-and-socket joint.

On the spring of a truss. The spring of a truss is a matter of importanee, although not so much as the pad and the directiou of the line of pressure. Its strength should be earefully regulated according to the requirements of the individual ease. It ought to be stroug enough to keep the pad in position, and prevent the deseent of the hernia uuder all cireumstanees, but not so as to cause paiu. The Freneh spriug eonsists of a eoil like like that of a wateh-spring, is always in aetion, and presses inwards. The German form is more rigid aud inelastie, and holds the pad firmly in its place, thereby resisting the protrusion of the hernia uuder any expulsive effort. The English makers employ a variety of springs. A too rigid one, as the German, is not to be reeommended, whilst the Freneh is also objeetionable, its aetion being too severe and eonstant.

The best is that whieh holds the pad in position, keeps it there under all moveueuts, eounteracts any expulsive action of the hernia, and eauses little if any discomfort. The lighter it is under these eir-eumstances the better, aud the eloser it is adapted to the body the more eomfort it affords.

The Moc-main lever. The only truss that has no eireular-body spring, and is kept in position by a band is the Moc-maiu lever. The pressure is kept up by means of a thigh strap attached to a small spriug-lever eonnected with the pad. Sueh a truss is doubtless eomfortable, as its action is not enough to produce iueonveuienee, but it is not safe under most cireum-stanees. In old people where the inguinal rings require only a little support, it may be used; but in the middle-aged, when the hernia has a tendeuey to eome down, it is a dangerous and unreliable iustrument.

Situation of pad of truss on rings. In oblique inguinal hernia the pad of the truss should be plaeed *over the internal ring and canal*, and not over the external ring, the object being to give support to the weak internal ring; in direct inguinal it is plaeed over the external ring. In femoral hernia, wheu the crural areh is natural and not relaxed, a small pad may be employed over the neck of the sac; but wheu the areh is relaxed and movable, a large pad, so adjusted as to press upou the ligament itself, is required. After the operation of herniotomy for erural heruia, this fact is worthy of atten-tion; for when a free division of Gimbernat's ligameut has been made, the ueek of the sae is always large and the ligameuts relaxed.

Varieties of truss. To give a deseription of every variety of truss is ueedless.

Egg's truss is in all respeets rigid, and keeps its plaee wheu ouec

fitted. *Coles's truss* is very good, is light, and has a thin metallic pad covered with leather, and acted on by spiral rings. When properly adapted with a not too convex pad, it gives elastic pressure; but is not so well calculated to retain a hernia under violent exertion as another truss with a more solid pad; the elastic pad being apt to yield and allow the hernia to descend. This objection applies to all elastic pads, although air or water pads, in some cases, are very comfortable and valuable, particularly in the healthy aged subject.

Among the trusses with solid pads that of Wood's must be mentioned. They are made by Matthews, with flat pads, composed of wood, ivory, or vulcanite, an india-rubber water-bag being occasionally applied to the surface of the pad. They are held in position by a spring that encircles the body. The size of the pad varies with the nature of the hernia, and the size of the hernial aperture. For oblique inguinal hernia, the pad is of an obliquely curved horseshoe shape, the outer limb over Poupart's ligament being shorter than the inner, and the spermatic cord and pubic spine lying in the cleft. The curve of the horseshoe is placed over the inner hernial aperture. For direct inguinal or umbilical hernia, the pad is made the shape of an ovate ring with a hole, corresponding to the hernial opening in the centre. For femoral hernia, the pad is egg shape.

Newsom's truss has a thin round wire-spring and a hard pad, which is very comfortable when well adapted.

The truss of Dr. C. Edwards, of Cheltenham, is good, the pad being so arranged that it may revolve as well as slide on the spring when required. That of Salt, of Birmingham, and L'Estrange's, are also good instruments. Millikin, of St. Thomas' Street, makes also an excellent truss with a pad, which, being movable upon a ball-and-socket joint, is readily adapted to any case.

A simple, yet a very efficient truss has, for some time past, been made by Messrs. Krohne and Sesemann, designed by Mr. R. Rendle, late surgical registrar at Guy's, for keeping up either a single or a double rupture. It consists of a circular steel spring covered with vulcanite, and made to fit the pelvis closely, an inch below the hip. At both ends of the spring there is a slot in which vulcanite pads slide, one for the left and another for the right side. If a hernia exists on one side only, the spring pressure on that side is made the strongest, the pad on the other side acting as a protection from rupture.

The main objects of a truss.

Whatever truss is selected to be of use it must answer to a nicety the purpose for which it is required. The pad should be adapted to the abdominal hernial orifice or to the hernial tumour itself, and not below it. The amount of pressure applied to the pad ought to be carefully regulated as well as its direction, and enough employed to keep the pad in position under all circumstances, without causing pain. A slight force applied in the right direction being of more value than a greater misdirected.

The pad may be flat or slightly convex, and made of a solid or elastic material. Of the latter, air, water, or springs may be employed, according to the requirements of the case. Sand pads are of great value, as they can be moulded to fit more comfortably and accurately than any other.

To test the value of a truss.

To test the value of a truss.—The patient should be made to cough and strain, and, when possible, to jump. He should be placed on the edge of a chair with his legs apart, or made to stoop forward with his

knees apart and his hands resting on his knees and then to cough, these positions tending more than any other to relax the lower parts of the abdomen and to loosen the truss. When the hernia by these means fails to descend or to excite in the patient a sensation of weakness in the region of one of the abdominal rings, the truss is probably efficient. The patient should be taught, under all circumstances, what the truss is expected to do, and be made to understand the danger he will incur if it fail in its purpose, as well as the necessity of again seeking advice.

The surgeon, moreover, should always take upon himself the responsibility of seeing that the truss fits, and not rest satisfied by sending his patient to buy a truss where he likes and of what kind he likes; he should also tell the maker what is wanted, and not leave him to find it out.

To measure for a truss.

To measure for a truss.—The following points should be noticed, viz. the nature of the hernia, the size of the hernial aperture, the side, or if double. The circumference of the pelvis should also be given one inch below the crest of the ilium, and the girth of the body, commencing and ending at the hernial orifice, as well as the distance from the hernial aperture to the iliac spine. The surgeon, moreover, should always indicate to the maker the directions of the pressure required by the pad, and this should always be made out when the patient stands, by a digital examination. In pendulous and fat subjects with inguinal hernia, it may be upwards, backwards, and inwards; in thin subjects simply backwards. In femoral rupture, the plane of the crural ring is horizontal, and may be closed by a backward pressure. No general rules can be laid down, though this is a point upon which the whole value of the truss depends.

To estimate the force required to keep the hernia in position is a difficult matter. Up to the present time the only true test is that of trial. Mr. Wood has had an ingenious pressure-gauge made for the purpose, which may possibly turn out of value. ('Brit. Med. Journ.,' October 12th, 1871.) Mr. Holthouse has likewise invented a skeleton truss which promises to be of use for indicating the length and shape of the spring required, and the correct angle at which the pad should be fixed.

Extra spare truss.

Patients who are liable to employ at times great muscular exertion should have two trusses, one for ordinary wear with a sufficient press power to keep the hernia in position, and the second with an increase of power which is to be put on when occasion demands. They should also have extra bathing trusses.

When a double truss to be used.

When any tendency exists for a double hernia, as indicated by a bulging of the opposite ring or a sense of weakness on making exertion, a double truss should be worn; indeed, in inguinal hernia, I believe that a double truss should always be employed. It is at least as comfortable as a single one, besides being an extra protection if well adjusted, and can do no harm.

Birkett, 'Holmes's Syst.,' vol. iv, ed. 1870; 'Med.-Chir Trans.,' 1859.—*Bryant*, 'Guy's Reports,' 1856; 'Clin. Surg.,' Part 3, 1861.—*Cooper's* 'Surgical Dict.,' 8th ed.—*Gay*, 'On Hernia,' 1848.—*P. Hewett*, 'Med.-Chir. Trans.,' 1844.—*Hutchinson*, 'Lond. Hosp. Rep.,' 1865.—*James*, 'On Hernia,' 1859.—*Aston Key*, 'On Hernia,' 1833; 'Guy's Rep.,' 1842.—*Kingdon*, 'Med.-Chir. Trans.,' 1864.—*Luke*, 'Med.-Chir. Trans.,' vols. xxvi and xxxi.—*Lawrence*, 'On Ruptures,' 1835, 5th ed.—*Stephens*, 'On Obstructed Hernia,' 1829.—*Scarpa*, Wishart's ed., 1814.—*Ward*, 'On Strangulated Hernia,' 1854.—*Wood*, 'On Rupture,' 1863.

CHAPTER XVI.

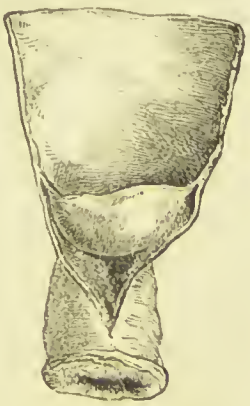
SURGERY OF THE ANUS AND RECTUM.

(Malformations.)

Varieties of malformations of anus and rectum.

The anus and rectum are not rarely the seat of congenital malformations, and these show themselves in a variety of forms. In one class of cases the anus is completely closed, the rectum being either partially or wholly deficient; in a *second* the anus exists in its normal condition, but opens into a *cul-de-sac*, the rectum being partially or wholly deficient (Fig. 286); and in a *third* the anal orifice is absent, the rectum opening into the bladder, urethra, vagina, or other abnormal position. And, it will be observed, says Mr. Curling, to whom we are indebted for the bulk of our information on this subject ('Med.-Chir. Trans.,' vol. xliii), that the classification of these imperfections is founded on states that can generally be recognised during life; although, unfortunately, the conditions of the terminal portion of the intestinal canal, and its relation to the parts around, cannot be predicted with any certainty; since in cases of imperforate anus, or of anus opening into a cul-de-sac, the intestinal canal may terminate in a blind pouch at the brim of the pelvis, the rectum being wholly wanting; or, an imperfect rectum may form and show itself as a short sac descending to the floor of the pelvis, or to the neck of the bladder in the male, or commencement of the vagina in the female. An explanation of these different conditions is to be found in the fact, that these malformations are clearly due to some failure in the fœtal development and to the want of junction of the two ends of the rectal tube; for the *anal* portion of the bowel developing from below, grows upwards, while the *intestinal* descends from above. The two parts subsequently advance, and, in a natural condition, unite, the membranous diaphragm at the point of their junction, at a later period, disappearing by interstitial absorption. When a failure in this uniting process takes place, the second class of congenital imperfection is formed; when the failure occurs at an early period of development, the two ends of the approaching tubes will be far distant, and, when at a later period, they may be in closer contact. The closure of the anal orifice is due to a firm adhesion of the integument.

Fig. 286.



Anal cul-de-sac.

Showing the intestine ending as a cul-de-sac above the anus. Prep. 188^{275}, Guy's Hosp. Mus.

Sometimes the blind pouch in which the intestinal canal terminates is connected with the anal integument, or with the anal cul-de-sac, by a cord prolonged from the bowel above, and it seems possible, from Curling's and MM. Goyrand and Friedberg's observations, that such cases are caused by an obliteration of the bowel which was originally well formed, from some intra-uterine inflammatory action; instances being on record where the muscular tissue of the intestine was clearly traced into the cord. Where the

upper bowel communicates with the urinary or vaginal passages, it is owing to the incomplete separation of the natural cloaca that exists during the development of those parts.

A clear understanding of the way in which these deformities are caused will explain the difficulties that are met with in their treatment.

Treatment where there is an anal cul-de-sac.

Treatment.—On the birth of every child, the condition of the different outlets of the body should invariably be examined, and even when the anus appears normal, a digital examination should be made on the second day, if the bowels have failed to act, as many an infant's life has been lost for the want of this attention and the consequent postponement of surgical relief till too late a period.

When simple.

In the *simplest* cases when the anus is closed by a thin membrane and the bulging of the distended rectum indicates its nature, a cautious central incision through the soft parts should at once be made, and a good result is generally obtained, the power of the anus usually being complete. Mr. R. Harrison, of Liverpool, records the case of a child who was born with an imperforate anus, and was successfully operated upon in the anal region *thirty-three days* after birth. ('Lancet,' Feb. 26th, 1876.)

When complicated.

In the *more complicated* cases where the anus is closed or absent and *no bulging of the bowel exists*, where the surgeon has no means of making out the true position of the terminal end of the bowel, a cautious incision may be made over the spot in which the anus ought to be found, the finger of the left hand acting as a pilot, but this must be carried out with care. The incision may be free as long as it is carried upwards and backwards towards the sacrum, and not forwards towards the urethra or vagina. It must not, however, be made too high. Where there is not sufficient room to carry out this practice, the coccyx may be cut away.

Avoid deep exploration.

When these means fail, all further attempts must be relinquished. To introduce a knife or a trocar and canula blindly upwards with the vain hope of puncturing the distended bowel, is a practice to be unhesitatingly condemned. Mr. Curling's figures, too, prove that the perineal exploratory operation unless undertaken with great care, does more harm than good; though when skilfully performed it is followed by considerable success.

Treatment where cul-de sac high up.

In the treatment of the second class of cases, when the rectum terminates above in a cul-de-sac, an exploratory operation may be made as just described, but the uncertainty as to the true position of the bowel renders any operative proceeding hazardous. When the two tubes are in contact and only separated by their membranous ends, as in the case illustrated (Fig. 286), a good result may be expected, but, when they are far apart, no such success can be anticipated. Mr. Curling in his table gives 31 examples of this class of cases. In 27 an attempt was made to reach the bowel, in 16 with success, while 10 of these subsequently recovered.

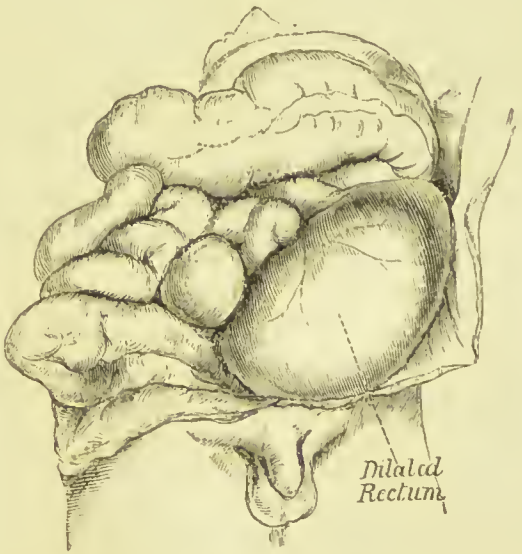
Intestine to be drawn down if possible.

When the bowel is opened in any of these cases and is not far from the anus, the surgeon should use all fair endeavours to draw down the intestine to the margin of the external opening and fasten it with sutures to the skin. He cannot often, however, succeed in accomplishing this, the bowel being rarely found at a less distance than an inch from the perinæum; but when possible, the advantages of the practice are great. Where this cannot be attained, repeated dilatation of the

perforated bowel is absolutely essential to maintain its patency, as otherwise, like all artificial openings, its subsequent contraction will take place. The introduction of a finger once or twice a week is sometimes sufficient for this purpose, and in a case I had under my care, where the tendency to contract rapidly was marked, the introduction of a large sea-tangle tent answered admirably, the tent being placed in water for a few minutes beforehand to make it swell. Repeated dilatation.

When the anus opens in an abnormal position, as in the vagina, and the anus made by the surgeon is established, there is a natural tendency for the abnormal opening to close, several cases being on record in which this result ensued. Two have occurred in my own practice. When success has followed any operative procedure in these cases, it is important that close attention should be paid to the condition of the bowel for many years, and indeed for the whole of life, because there seems reason to believe, that the bowel which forms the upper cul-de-sac has but little muscular power, and is liable to dilate under fæcal collection as well as to become paralysed, death under these circumstances taking place from obstruction. In Fig. 287, this fact is illustrated. It was taken from William L—, æt. 26, who had been operated upon as an infant for an imperforate rectum. He died in June, 1874, from exhaustion and peritonitis following intestinal obstruction, this obstruction being clearly due to the narrowing of the rectum at the seat of the early operation. At the post-mortem, the rectum was found to occupy half the abdominal cavity and was thirteen inches long and eleven in circumference. Its walls were three times as thick as natural, more particularly the peritoneal coat. Tendency of opening to close. Case.

Fig. 287.



Enormous dilatation of the rectum following obstruction due to the contraction of an artificial opening made into an imperforate rectum twenty-six years previously.

When the exploratory ano-perinæal operation has failed to give relief, or when it is inexpedient to make the attempt from the very

Operation through the abdominal walls.

backward position of the genital organ, other measures must be adopted, and of these the opening of the large intestine through the abdominal wall is certainly the best. M. Rochard, in the 'Mémoires de l'Acadéemie Impériale de Médecine,' 1859, gives ten authentic successful cases of Littre's operation in the groin for this affection. Holmes informs us, in his admirable work 'On the Surgical Diseases of Children,' that he had not met with the account of any permanently successful operation since the publication of Rochard's paper. Guersant opened the colon in the groin eleven times in succession, and once in the loin, without saving a patient. Giraldès, however, had one case in which a child lived two months and a half and then died from another cause.

Inguinal operation.

The operation, to be successful, must be undertaken early, before the infant is exhausted and peritonitis set in. Delay is only justifiable when the bowel is not distended and the symptoms not in any way urgent.

With respect to the form of operation, that known as Littre's is probably the best, viz. opening the bowel in the groin. The left groin is usually selected, although the right has been recommended by Huguier on account of the frequent bend in the colon towards the right groin, and the absence of the rectum in these cases. Giraldès also has shown from dissection, that in thirty infants operated on for imperforation, the intestine was found on the left in all. ('Nouveau Dict. de Méd. et de Chirurg. pratiques,' 1864.) I have on three occasions performed Huguier's operation with temporary success. In the last case, operated upon in December, 1876, the child (a male) was twelve days old before relief was sought, and he lived eight days, dying from chronic peritonitis, which had evidently existed before the operation. The artificial anus had been made in the lower part of the large intestine, and, had the operation been performed at an earlier period, good success would probably have been attained.

Lumbar operation.

The question is, therefore, still *sub judice*. Amussat's operation in the loin is rightly put aside in these cases on account of the natural looseness of the colon at this part in children, and the very usual oblique turn of the colon after its splenic flexure. Figures likewise help towards the same conclusion, since out of fourteen instances in which Littre's operation was performed, nine recovered, whereas two only out of seven recovered after the lumbar operation.

The operation itself has been described in page 630.

Treatment where rectum opens into vagina.

In the treatment of the third class of cases, where the rectum opens into the vagina, the surgeon may lay open the rectum from the position of the natural anus, having previously passed a director into the vaginal orifice of the gut as a guide, drawing down, when possible, the bowel, and fastening it to the integument by sutures, as originally performed with success by Amussat. As a guide to the perinæal incision, a bent probe may be passed into the vaginal orifice of the bowel, and the end turned towards the perinæum, cutting down carefully upon it. I have done this with success on four occasions, and in all, stitched the bowel to the margin of the integument, forming a good anus. In two cases, the vaginal orifice subsequently closed. In two, that were operated on several years ago, the patients have good control over their motions, while the vaginal fæcal fistula seems to be contracting, liquid motions alone passing.

In exceptional instances the deformity seems to cause no inconvenience. Ricord has recorded one ('Gaz. des Hôp.,' 1863) in which the woman was married and her husband was quite unconscious that anything abnormal about the parts existed. Le Fort has recorded a second in which the woman was married, and had had three children, the malformation having been accidentally discovered in an examination for some suspected disease of the bowel.

"In such cases as these," adds Holmes, "the termination of the rectum in the vagina must be tolerably free, and there must either be an external sphincter or the internal sphincter must be hypertrophied."

Where the bowel opens into the bladder or urethra.

When the *bowel empties itself into the bladder or urethra*, the case is very hopeless, though the prospects of a successful issue are better under the latter than the former conditions. An exploratory operation in the region of the anus may, however, be made with the usual caution, in the hope of reaching the intestine, and, on its failure Littre's operation should be performed. Mr. Curling has related a successful case of this operation in a boy, eight years of age, who had a good anus in the groin, yet suffered from the occasional passage of fæces into the urinary passages.

Summary.

By way of summary the following conclusions may be given:

1. In all cases, with some rare exceptions, of imperforate anus, obstructed rectum, or misplaced anus, an exploratory operation in the normal anal position ought to be made, success following the attempt in nearly half such cases.

2. Such exploratory operations, however, to be successful, should be undertaken early, and conducted with great caution—the line of puncture or incision being upwards and backwards towards the sacrum.

3. When these means fail, or are inapplicable, the intestine must be opened in the groin, it being still an open question whether the right or left side ought to be selected, though the latter is the usual one.

4. When an artificial anus has been made, its constant dilatation is a necessity.

For further information on this subject refer to Curling's paper, 'Med.-Chir. Trans.,' vol. xliii, and French edition of Holmes's 'Surgical Diseases of Children,' by Dr. Larcher. Bodenhamer, Wm., 'On Malformations,' Wood, New York, 1860. Ashton, 'On Rectum,' 3rd ed., 1860.

Injuries of the Rectum.

Injuries of the rectum.

The anal orifice and lower part of the rectum may be wounded by accident from falls, or by design, and, when this occurs, hæmorrhage is a common result. Repair, however, rapidly goes on in these regions, and with the arrest of bleeding by either securing the divided artery or by pressure, and water dressing, a good result may be anticipated.

Example.

In 1876, a severe example of this kind came under my care at Guy's Hospital, in a boy æt 12, who was impaled upon a rail, the iron spike entering the pelvis on the inner side of the right tuberosity of the ischium, perforating the rectum about two inches up, and lacerating the anterior wall of the rectum and base of the bladder. The injury was followed by collapse and attended with hæmorrhage. I saw him directly after the accident and made a free incision into his bladder as for lithotomy, in order to secure a free passage for the

urine; it being clear that the recto-vesical peritoneal pouch was lacerated. Some though not severe peritonitis followed; and fæces passed per anum as well as through the external wound. On the sixteenth day I consequently gave opium to lock up the bowels, with the view of making a splint as it were of the fæces, and to keep the rectum and intestinal wound quiet. Success followed the practice and the wound in the bowel closed. After four days, the bowels were opened after a dose of castor oil, and convalescence became established.

Ruptured rectum in parturition.

In parturition, the rectum is sometimes laid open by a rupture, either alone or with the perinæum, and, when this occurs, the rent ought to be brought together at once, for if this practice be not adopted, a plastic operation subsequently will have to be performed.

Laceration from act of defæcation.

In the *act of defæcation*, small lacerations of the anus are not uncommon, when the motions are very large or hard; and H. Mayo ('Dis. of Rect.,' 1833) relates the case of a lady who, during a violent effort at defæcation, felt something give way, and, on the following morning, discovered fæces in her vagina. An examination revealed a rent two inches up the bowel large enough to allow the end of the finger to pass from the rectum into the vagina. Cases are also on record, when, during parturition, a child's head passed into the rectum and was delivered per anum.

Treatment.

In the milder forms of laceration of this kind, cleanliness and laxatives, as a rule, are sufficient to allow the parts to heal. In some instances, the rent does not heal and the case becomes one of fissured anus or painful ulcer of the rectum, and should be dealt with accordingly.

Wounds of the rectum inflicted by the surgeon, as a rule, heal readily, as is fairly proved by the cases of fistula in ano treated by operation, and the recto-vesical operation for stone. The puncture made in the operation of tapping the bladder per rectum for retention also heals quickly.

It is well to remember, that the rectum may be wounded by the passage of a bougie, enema syringe, or the introduction of an O'Beirne's tube. Guy's Museum contains specimens illustrating all these forms of injury, and, at St. Bartholomew's there is a specimen of perforation of the rectum by a metallic clyster pipe, through which gruel was injected into the peritoneal cavity.

Foreign bodies in the Rectum.

Foreign bodies in the rectum.

These may be introduced from *without*, either from mischief or accident, and trouble may be experienced in their removal, their shape and position influencing the result. More commonly, however, they have been swallowed, and have passed down the canal, becoming caught or impacted in the rectum. They are not unfrequently the cause of anal abscess; bones, pins, bristles, &c., being constantly found in the rectum under these circumstances. Stones, hairs, or husks may likewise form concretions that are foreign bodies. When large foreign bodies have been introduced into the rectum, or concretions or solid masses of fæces become there impacted, chloroform should be given to allow of their removal, care being taken not to injure the walls of the bowel more than can be helped. With the patient under the influence of chloroform, the sphincters become so relaxed as to allow of the introduction of large instruments, or even the introduc-

tion of the hand to guard the bowel and remove the foreign body. Bottles, pots, cups, corks, rings, pencil cases, bougies, sticks, &c., have been impacted in these regions, and considerable care is needed in their removal to prevent injury. The injection of plenty of warm oil before the attempt greatly facilitates the operation. Lithotomy scoops or forceps are likewise valuable, but the ingenuity of the surgeon is necessary in every case to apply the best means to carry out the end in view. Treatment.

A large collection of such cases with their treatment is given by M. Morand in 'Memoirs of the French Academy of Surgery,' vol. iii, and by Ashton in his work 'On the Rectum.'

Diseases of the Anus and Rectum.

These have only recently received sufficient attention from the great body of surgeons, and, as a consequence, have been too often allowed to fall into the hands of "quacks;" and, although able and respectable specialists have since rescued this important class of cases from their hands, much remains to be done by the profession as a whole, to bring the diseases of these parts into their right position, that is, into the hands of the general practising body of the profession. Again, in no class of cases are so many mistakes met with, and these almost always arise from a want of proper local examination of the parts. The anus or rectum is either unlooked at or unexamined from some mistaken notions of delicacy, or badly examined from want of knowledge or want of inclination. But such should not be, and every patient who complains of anything like persistent symptoms in those regions should be as carefully examined as he or she would be were any other locality equally affected. To do this, some nicety is required, and, to help the student the following hints may be acceptable. On diseases of the anus and rectum. Their study neglected.

Examination of a patient.

The best position is on the side with the legs well drawn up and thighs flexed upon the abdomen, the hips being brought to the edge of the bed or couch in a good light; the surgeon, with one hand having uncovered the parts sufficiently to expose them, may then raise the upper buttock, and in doing this, the anus comes well into view; in operations, this may be done by an assistant. When an abscess exists, it will then be seen; if a fistula be present, its external orifice will be apparent. Fissures, warts, condylomata, or fleshy, flattened, cutaneous vegetations, or cancerous tubercles, will also be at once recognised. Mode of examining the rectum.

Pendulous loose folds of skin about the anus will suggest the former existence of external hæmorrhoids; blue, turgid, venous projections their present existence. A tightly contracted and rigidly drawn up anus, as a rule, means some painful ulcer of the part, and a patulous anus through which flatus or discharge passes without the patient's wish, too often indicates extensive rectal ulceration or stricture. Loose folds of skin.

Internal piles when prolapsed will appear as turgid, vascular, mucous projections, covered with mucus or blood, surrounded by everted integument more or less œdematous; *prolapsus* recti, as a greater or less annular projection of smooth or rugous mucous membrane, with a central intestinal orifice. A *polypus* projecting will appear as a cherry, surrounded by healthy structures. All these points Interna piles.

are taken in at a glance, and understood. A digital examination should then be employed to confirm or refute the suggestions thus taken in by the eye. To do this well, the index finger must be thoroughly anointed with lard or ointment, it being a good plan previously to fill the nail with a piece of soap. It should then be applied to the anus, and the patient told to bear down, as in doing this the sphincter is relaxed. The surgeon can then with ease, and without pain, introduce his finger. When an ulcer exists at the anus, pain will be caused by, and spasmodic resistance offered to, the introduction of the finger, and, with the pulp of the finger slowly moved round the anus, the ulcer will probably be felt. It should be stated, however, that in many cases, this ulcer will be seen by a careful drawing down of the skin of the anus till the margin of the mucous membrane becomes visible. A spongy nodular feel of the mucous membrane just within the sphincter will suggest internal hæmorrhoids; a local, tender, and raw surface, the probability of a simple ulcer; a circular, indurated raw surface that of a syphilitic sore, while a cancerous ulcer is known by an infiltrated nodular and thickened surface. A stricture within two inches of the anus can always be detected by its annular form or the obstruction which it causes. When a healthy piece of bowel separates the anus from the stricture or ulceration, the probability of the disease being cancerous is rendered great. When no such healthy tissue exists, syphilitic disease is rendered probable. A digital examination will always detect the presence of scybala or impacted fæces, and also the encroachment of uterine or pelvic tumours in women, and prostatic tumours in men. To confirm these opinions thus formed, a speculum may be used, which should be introduced, well warmed and greased in the same way as the finger. Mr. Curling says, "when the mischief is high up in the rectum let the patient stand on the left leg, with the right thigh and leg bent, the foot resting on a chair. Tell the patient to strain. This action will then force the parts down." I have found this method of examination serviceable.

For ulcer in the rectum.

Stricture of rectum.

Cancerous disease.

Use of speculum.

Mr. Allingham "advises the prone position, with the hips well elevated upon hard pillows, to such an inclination that the intestines will gravitate towards the diaphragm, so that when expiration takes place the rectum becomes patulous, and you can see as far as the sigmoid flexure perfectly distinctly." This mode of examination, he informs us, was suggested by Dr. Marion Sims. ('On Diseases of the Rectum,' 1871.)

The speculum represented in fig. 288, as made for me by Krohne, is the one I prefer.

Introduction of hand into rectum.

The practice of introducing the whole hand into the rectum has been frequently adopted by several good surgeons, and, from my own personal experience, I believe it to be of value, more particularly for diagnostic purposes, in cases of suspected disease of the rectum above the brim of the pelvis, in pelvic or abdominal affections. In the female patient, it is more readily performed than in the male. The operation, however, is neither easy nor free from risk, since laceration of the rectum has been recorded. It should be performed with the patient under the influence of an anæsthetic, and with extreme slowness (five minutes may well be spent in passing the sphincter ani); the hand should be well greased and introduced with a screwing motion. When the hand has passed within the rectum, much care is required,

and, when the narrowness of the gut forbids easy advance, no force should be employed, for by force the peritoneal covering of the bowel has been ruptured. With the hand in the rectum, the parts above the brim of the pelvis may be readily examined; indeed, the kidneys have been felt, and pulsation in the larger branches of the abdominal aorta can be traced, and consequently controlled.

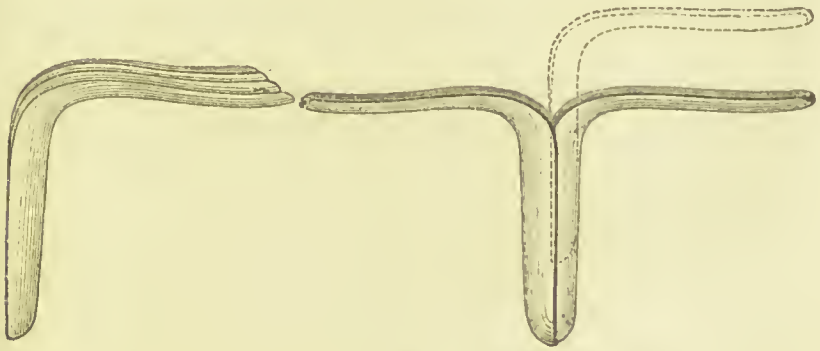
With these brief general remarks, I now proceed to treat of the special affections.

Fissure and Painful Ulcer of the Anus.

On fissure and painful ulcer of anus.

This most distressing affection produces more misery than any other local disease with which I am acquainted, and renders the natural act of defæcation an agonising one, often "causing great drops of perspiration to course down the temples." It is usually caused by the mechanical splitting of the orifice of the anus from the passage of a large or indurated motion, at the junction of the mucous membrane of the bowel with the skin, although it is not always traceable to such a cause. In some instances it seems to owe its origin to scratching the parts when highly irritable. It is usually a disease of adult life, and common to both sexes; though it has been found in children, even so young as a year and a half. ('Brit. Med. Journ.,' June 6th, 1874.) It is met with as often in the healthy as in

Fig. 288.



A nest of three. Rectal speculum. Two adapted for use.

the feeble subject, but where it has been allowed to go on uncontrolled, it soon tells upon the strongest patient. Constipation, high feeding, sedentary habits, and want of local cleanliness, are the common causes, but anything that sets up irritation in the intestines is likely to produce it, and, when once started, unless treated with discrimination, it may go on for years; indeed, it is by no means unusual to hear, that the symptoms have been endured for two, four, or even six years. It generally manifests its presence by some local uneasiness in the act of defæcation, this uneasiness passing on to more or less severe pain. This pain, as a rule, is experienced during the passage of the motion, but in some instances it comes on after the lapse of a few minutes or even an hour or more after the act, and may last a few minutes or hours. When it passes away, the patient is easy till the same cause excites the same symptoms. The motions will often be streaked with a line of pus or blood and diminished in size, sometimes being flattened, at others

Effects produced by the local disease.

Symptoms.

pipe-like, and this diminution is produced by the spasm of the sphincter, the size of a motion being, in disease as in health, greatly determined by the condition of the sphincter.

Local signs. On examining the anus, the first fact that strikes the observant eye is the unnatural resistance the patient makes on separating the buttocks; and, on doing this, the powerful contraction of the sphincter that will be visible. On attempting to introduce the finger, considerable resistance will be encountered, and the greatest pain caused if the surgeon persevere in his attempt.

External examination. The symptoms and local signs of the affection are indeed so characteristic, that the true nature of the case can, as a rule, be diagnosed without the aid of a digital *internal* examination; and a careful *external* examination will often reveal the presence of an ulcer on the verge of or within the sphincter; when within, its outer border will be visible.

Situation and size of ulcer. The ulcer is usually though not invariably placed at the posterior margin of the anus, and is rarely larger than a sixpence, if so large. When recent, it will be soft, with slightly elevated edges; and when of long standing, indurated with an irregular surface, small polypoid growths fringing its border. The ulcers are at times multiple, in exceptional cases involving the bowel higher up. It is an affection of the mucous and submucous tissue, and painful only from its position, besides being obstinate in healing from its connection with the sphincter ani. Simple fissures of the anus rarely involve other than the mucous membrane and skin around the parts, and are often associated with piles, though occasionally with small polypi. Ulcers are often hidden from view when piles or folds of skin exist about the anus, but pain indicates their presence.

In women this affliction is so often associated with reflected uterine symptoms as to be frequently overlooked, and in men, urinary irritation may mask the disease. Reflected nerve pains in the perineum and down the leg as in sciatica, or in the loins as in lumbago, &c., are often induced by the affection.

Treatment in simple fissures. TREATMENT.—Happily for patients, the treatment of this disease is as successful as it is simple. *Simple fissures* are readily treated by the administration of a laxative, the local application of the nitrate of silver or of lead lotion mixed with the extract of opium, and local cleanliness, with simple, nutritious and unstimulating diet. When the parts are indolent, or syphilis suspected, black wash may be used, or calomel dusted over the part, or applied as an ointment, five grains to a drachm of lard. In other cases, the application of mercurial ointment with the extract of belladonna gives relief. Injections of the decoction of rhatany twice a day, or of an enema composed of a drachm each of the extract and tincture of rhatany in five ounces of water are sometimes of great use, as also iodoform as an ointment ten grains to the ounce.

In ulcerations. When a larger *ulcer exists*, the cause of spasm and pain, and is quite recent, the same treatment may be employed; but, when the ulcer has existed for any time and has a hard base, it is quite exceptional for a cure to take place by these means, the surgeon being hardly justified in making the attempt, when he has at hand such an efficient means as *the division of the base of the ulcer with the superficial fibres of the external sphincter.*

Division of the ulcer and fibres of sphincter. This can be done in many cases by the introduction of the finger with a probe-pointed bistoury pressed flat upon it, to the upper margin of the ulcer, and the division of the base of

the ulcer by turning the edge of the knife towards the surface of the ulcer and then incising it. Boyer, who first suggested the principle of treatment, advised the free division of the sphincter, but Copland and Brodie introduced the minor operation, which in the bulk of cases is sufficient to effect a cure. In very chronic instances, Boyer's operation may be demanded. When chloroform is given, a speculum may be used, and the ulcer being exposed, divided by a sharp bistoury, transfixing the tissues at the base of the ulcer on cutting inwards. The essential point of practice to observe is, the free division of the base of the ulcer down to healthy tissue, the mode of doing it being unimportant. When any fold of skin or pile exists near the ulcer, it should be removed. Mode of performing.

The *forcible dilatation* of the sphincter, and its laceration with the thumbs in the rectum, as practised abroad, is a barbarous treatment compared with the above, though when a patient is under chloroform it may be followed. Forcible dilatation condemned.

In the after-treatment, the bowels must be kept slightly loose, and for this purpose nothing equals in value a mixture of one ounce of olive oil, rubbed down with forty-five grains of carbonate of potash, and mixed with seven ounces of peppermint or chloroform water, one ounce being given two or three times a day to produce a soft evacuation. Indeed, before as well as after the operation, this mixture should be employed; when it fails, enemata ought to be used. The diet should be simple and rest maintained till the cure is complete, for where this rule has not been observed, I have known the ulcer become so indolent as to require a second division, which, under other circumstances, is rarely required. Tonics are often of value during the convalescing period. After-treatment. Mistura Olei.

Spasm of the sphincter is not a disease but a symptom, caused by reflected irritation from some rectal, uterine, or other local affection. It may be a small or superficial ulcer beyond the verge of the anus, the presence of worms, the existence of a small polypus, or some other cause of irritation of the mucous membrane lining the bowel, but a local cause will be found after careful investigation. Spasm of sphincter.

The same remarks are also applicable to *neuralgia of the rectum*, though it is quite reasonable to believe, that a pure neuralgia may occur of this part as of any other. Yet, as a rule, it is caused by reflected irritation from some nerve with which the part is connected, and the surgeon should clinically so regard it. It is said to be common in gouty subjects, and can certainly be relieved by free purgation. Neuralgia of rectum.

Dr. T. Ringer, an able surgeon in the Indian army, has related to me several cases of this complaint clearly caused by malaria, and cured by large doses of quinine.

Anal Abscess and Fistula in Recto.

The two subjects of anal abscess and fistula in recto are classed together, as the latter disease is almost always preceded by the former, though a large number of cases of anal abscess recover without passing into a fistula. Of my notes of 236 consecutive cases of the two diseases, 43 commenced and ended as anal abscess, while the remaining 193 were treated as fistula in recto; 74 of these cases were females, and 162 males, men being evidently more liable than women to this affection. It rarely occurs in children, though I have successfully treated a case in a male child four months old, and a second in one of fifteen months; in the latter the fœtor of the discharge was very great. Anal abscess and fistula in recto, considered together.

Causes.

Of the causes of this disease, little positive information can be given, because, as a rule, the abscess is obscure in its origin, slow in its progress and repair; some patients even professing to have been unconscious of its existence till it was about to burst. In other cases, however, they are very *acute* in their action, and very painful.

Not always dependent on ulceration.

That an anal abscess must always result from some ulceration of the bowel within the sphincter is an opinion which can scarcely be regarded as true, there being no evidence to support such a view, and the fact that so many as forty-three out of 236 cases of anal abscess recovered without forming a fistula goes far to prove its error. It is not unfair, therefore, to infer that in many cases, it depends upon a different cause.

Fistula generally follows abscess.

In fistula in recto this argument must be equally strong, since it is generally believed that this affection is merely the sequel of the anal abscess; we must, consequently, look for some other and more general cause than that ordinarily received, namely, perforation of the bowel from ulceration.

Mechanical irritation a cause.

The mechanical irritation of a foreign body is doubtless an occasional cause, it being by no means uncommon for a surgeon to remove from the anus, when opening an abscess, a piece of fish-bone, bristle or other foreign body. Quite recently I removed a pin.

May occur at any period of life.

These affections may occur at any period of life, though I have seen a fistula in a child six months old, and, in the majority of instances it is found in adults between twenty and forty years of age. Dr. Lipscomb, of St. Albans, related a case to me which took place in his practice that was congenital, the mother having conceived when worrying about her husband, who was suffering from fistula. It is very common to be informed that the fistula had existed for several years before surgical aid is sought.

Connection between phthisis and fistula.

With respect to the connection between phthisis and fistula, it is difficult to give any positive information. During the eight years that I was registrar at Guy's, I inquired carefully into this point in every case, but had only 3 out of 193 in which either hæmoptysis or other symptom of marked phthisis were present. In the majority of cases, the patients presented no more severe cachectic symptoms than is usually met with in other hospital patients, and I confess to being somewhat doubtful as to the fact, that fistula in recto is a common consequence of phthisical disease. When, however, fistula and phthisis are associated, the former is usually of a bad form.

Varieties. Complete. Blind external. Blind internal.

When a fistula has two openings, one externally and the other into the bowel, it is called *complete*. When there is an external but no internal opening to be found, it is known as the *blind external*. When an internal but no external, *blind internal*.

That as a rule an internal opening exists is now scarcely doubted, although at times there may be great difficulty in finding it. M. Ribes in 1819, examined the bodies of seventy-five people who died with fistula, and in all he found an internal opening; in nearly all, this was placed just within the sphincter, but in no instance was it higher than half an inch. Modern surgeons now accept these facts. The pus that forms in these parts is very offensive at times, as often from the absorption of fœtid gases through the mucous membrane as from the mixture of fæculent matter. In a large number of cases, the discharge has no fæcal odour.

It should always be remembered that an anal fistula may accompany severe rectal disease, such as stricture or ulceration, or that it may be connected with disease of the pelvic bones, &c. In the case of an old man with an enormous abscess between the base of the bladder and the rectum, constitutional symptoms were very severe till two deep incisions were made on either side of the perinæum, giving exit to a quantity of pus, when an excellent recovery ensued. In this instance it was a question whether the prostate gland was in fault, but no other symptoms of such a complication could be ascertained.

Fistula may accompany other diseases.

TREATMENT.—In cases of anal abscess *free incision* is the best practice, which should be made as soon as fluctuation can be felt externally or through the bowel. Deep-seated abscesses in these regions should not be left to natural processes to open. When the abscess is in front of the anus and rectum, an early opening may be called for on account of the retention of urine to which it may give rise. The incision should be made from without inwards, in a line radiating towards the anus. In deep-seated abscesses, one or two fingers may be inserted well into the rectum, and the abscess pressed forwards before the incision is made, a sharp straight bistoury being the best instrument to use. A piece of oiled lint should be inserted into the wound, and kept there for a day.

Treatment of anal abscess.

When deep seated.

In a case I saw, in 1872, owing to the neglect of making an early opening, emphysema and phlegmonous inflammation of the perinæum, scrotum, penis, and abdomen even up to the axilla took place, a free communication evidently existing between the bowel and the abscess. The patient died from the constitutional irritation of the disease. The sloughing of the cellular tissue was very extensive and the fœtor of the sloughs was something to remember.

Consequence of not making early opening.

After the abscess has been opened, the patient should be kept at rest in the horizontal posture, water dressing applied to the wound, and the most perfect cleanliness observed, laxatives being given when the motions are hard, and also tonics to improve the health.

When a *fistula exists*, the best operation is its division into the bowel, the action of the sphincter ani having, doubtless, a powerful influence in retarding repair. The bowels should previously be cleared by a mild purge two days before the operation, and an enema given on the morning of its performance. The patient should be placed on the side upon which the fistula exists, with the legs well drawn up, and brought to the edge of the bed or couch, such position being better than that on the elbows and knees, or the stooping over a chair. An assistant should separate the buttocks. The surgeon ought then to introduce a fine probe-pointed grooved director into one of the fistulous openings, and, with the greatest gentleness, guide it through the fistula. Anything like force on the part of the sphincter will excite resistance to its introduction and cause pain. When the end of the probe passes into the bowel through the internal opening, all that is required has been effected, and if difficulty be experienced in doing this, the well-greased index finger of the opposite hand can be carefully inserted into the rectum and the internal opening felt for, through which, when found, the end of the probe can readily be guided into the bowel. When no internal opening exists (a rare condition), the director must be forced through the bowel at the upper part of the sinus.

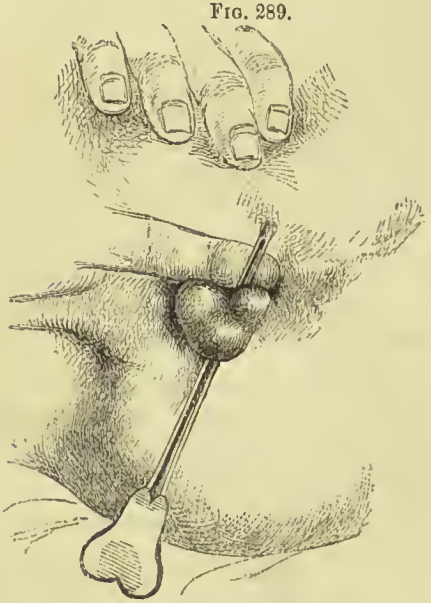
Treatment of fistula in ano.

Operation of dividing a fistula.

As soon as the director is felt in the rectum, the patient should be told to strain, the surgeon, at the same time, with his index finger hooking its end downwards. By these means the director will be made to protrude from the anus, when the whole of the tissues bridged over can be readily divided (Fig. 289).

When the fistula runs high up and much force is called for to turn the probe out of the anus, it is better to pass a speculum and to divide the fistula.

Fig. 289.



Grooved probe passed through anal fistula before its division.

Where there is a long sinus.

When a long sinus runs up by the side of the bowel, it should be laid open through a speculum, to leave it alone not being a safe practice—for, although in some cases a cure may take place, in many the discharge into the rectum will continue and but little good will have been effected by the external operation. The presence of this internal discharging fistula is generally indicated by the appearance of pus upon the motion.

Where many sinuses.

When many sinuses exist, they should be laid open, although it is not necessary to divide the sphincter in more than one place, as a double division of the sphincter is apt to be followed by incontinence.

After-treatment.

After operation, the wound should be well plugged with dry cotton wool down to the bottom, and no careless introduction of the plug will suffice. By this measure, all bleeding can be controlled, and any amount of pressure applied by means of a T bandage. When no bleeding exists, only a moderate-sized plug is necessary.

On the second day, the dressing may be removed, there being no occasion to re-introduce the plug, a piece of oiled wool or lint gently introduced to absorb discharge being all that is required. The wound should be kept clean. When indolent, it can be stimulated by some lotion of nitric or carbolic acid, terebine, or tincture of iodine; tonics and good diet being also valuable. The horizontal position, not in bed but on a sofa, must be maintained, however, till the parts are healed.

In the *blind* internal fistula, a guide to the external wound may often be found by means of a bent probe hooked through the internal opening, and the case treated as any other.

When bleeding follows.

When severe bleeding complicates the case, a speculum may be passed, and the vessel seized and twisted. Where this cannot be done, the rectum may be well plugged with a sponge saturated in alum; but, as a rule, a well-applied pad and pressure, adjusted with a T bandage, are sufficient to control it.

A piece of ice put into the centre of a cup-sponge, and applied to

the anus, not only arrests bleeding, but gives great comfort in this as in almost all anal operations.

When a cutting operation is inexpedient, as in "bleeders," or, when the patient will not submit to it, the division of the fistula with a metallic wire, heated by the galvanic cautery, is a faultless method. Indeed, in all cases of fistula, where this apparatus can be obtained, it is the best means. It readily divides the tissues, the two ends of the wire being made to project through the two orifices of the fistula, thus burning their way out with a sawing movement. There is little pain at the time, and scarcely any after, with no loss of blood, and, what is more, no need of any subsequent dressing, as a cauterized surface must heal by granulation. Division by metallic wire and galvanic cautery.

When this plan cannot be followed, the treatment by ligature has been adopted. Mr. Luke revived the practice in 1845, but it has now fallen into desuetude. Were I called on to adopt the practice, I should use an india-rubber ligature. Treatment by ligature obsolete.

In rare cases, fistula may be treated by injection, a daily injection of the sinus with some tincture of iodine, sulphate of zinc, or nitrate of silver having been followed by a cure; yet such cases are too exceptional to justify the recommendation of such treatment. Injections.

When the patient's condition is such as to forbid any hope of repair in the wound taking place, the operation for fistula should be set aside; but the existence of pulmonary mischief, if not far advanced, is no argument against its adoption; nay, it may be made use of as an argument in favour of surgical interference—recent investigations, as already alluded to in an early chapter, having indicated that the long existence of suppuration is liable to set up tuberculous disease. Practically, however, it is undoubtedly true, that fistula may be divided, and heal in far from healthy subjects, and the general health improve after the operation. When operation unadvisable.

Hæmorrhoids or Piles.

In a clinical point of view, these may be divided into the "*bleeding*" and "*non-bleeding*." The *former* are generally the *internal*, and composed of a highly vascular tissue, involving the mucous membrane of the rectum and the submucous tissue, with enlarged arteries and veins. Where the arterial element predominates, the tumour has a bright red strawberry aspect; where the venous, a dusky hue. They are closely allied to nævoid structure and discharge arterial blood. On hæmorrhoids or piles.

The *non-bleeding* or *external* piles are composed of the loose folds of skin that surround the anus; or a varicose, inflamed or ruptured vein. When inflamed, these folds become œdematous and infiltrated with organized inflammatory products, and appear as fleshy growths of various degrees of density. The venous hæmorrhoids also become swollen, and appear as bluish, tense, and painful tumours. When in an active state, they may encroach upon the mucous membrane of the rectum and appear as large as a walnut, but, as a rule, they are about the size of a nut. They rarely give rise to much annoyance when cleanliness is observed; but, under other circumstances, they cause much local irritation. When swollen or inflamed, however, they give great distress, from the sensitive condition of the skin at these parts. External piles also are occasionally the cause of hæmorrhage, the blood at times coming direct from an ulcerated vein, and is then venous. At External piles.

other times it will be profuse, but its exact seat is not so evident. The flow comes from between the pendulous flaps of skin, and ceases when they have been removed.

Treatment of external piles.

The TREATMENT of these external piles is simple, and excision is the only radical cure. The pendulous flaps of skin that surround the anus may be removed with a pair of sharp scissors, the tumour having been drawn forward with a pair of forceps. These incisions should be made in lines radiating towards the anus. When coagulated blood has been poured out into the pile and a tense painful tumour exists, it may be punctured or laid open with a lancet; bleeding, when it occurs, being easily arrested by cold and moderate pressure. When the pile is inflamed, leeching often gives comfort, and the application of a poultice, covered with the extract of opium gives relief. When the part suppurates, the abscess may be opened.

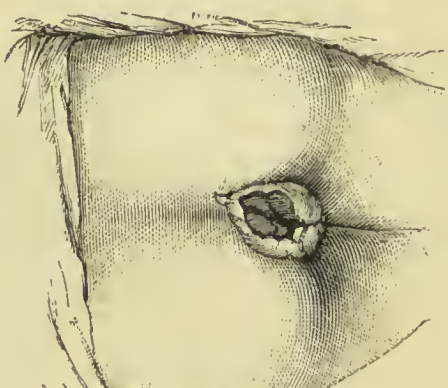
In the early stage of the affection, local cleanliness, the abstinence from highly seasoned food and strong wines are mostly sufficient, the bowels being kept clear by enemata, or the occasional dose of a mild aperient, such as the compound rhubarb pill before dinner, some saline purgative water or electuary. When local irritation exists, an ointment composed of equal parts of zinc, nitrate of mercury, and subacetate of lead is very valuable, some recommend also the compound gall ointment. An ointment of zinc and the extract of belladonna is very useful.

Internal piles.

Character and conditions.

Internal piles are very insidious in their growth; so insidious, indeed, that bleeding is often the first symptom that attracts notice. On inquiry, however, it may generally be made out that constipation has been the normal condition, and that irritation about the anus, with a feeling of heat and fulness in the parts, had previously existed. These piles often appear after parturition. When the parts *inflame*, there will be throbbing, and pain in defæcation; when they *protrude*, there will

FIG. 290.



Internal hæmorrhoids.

be one, two, three, or more masses of thickened mucous membrane with nævoid structure, presenting either a smooth and tense, or a reticulated surface. Sometimes there will be oozing of blood from the whole surface, or the blood may spurt from a distinct orifice. The blood is

almost always red and arterial, and the mucous projection is surrounded by skin, more or less pendulous, œdematous or infiltrated with inflammatory products (Fig. 290).

When the parts are not inflamed, this hæmorrhoidal mass may protrude only during defæcation, and return naturally, or, after a little pressure. When the disease has been of long duration, the pile may protrude on the slightest exertion, even on the patient assuming the erect posture or on coughing; the whole mucous membrane of the rectum often participating in the prolapse, and adding to the discomfort.

Pain attending them.

The *pain* attending the development of these piles varies vastly, small hæmorrhoids often giving rise to severe local distress, while the larger cause but little. An inflamed pile is, however, always painful, and a prolapsed, strangulated, inflamed one the most of all. Where pain is excessive, and more particularly after defæcation, there is a strong probability that a *fissure or ulcer* complicates the case.

Hæmorrhage as a symptom.

The amount of *hæmorrhage* bears no proportion to the extent of the disease. In one of the worst cases of hæmorrhage I ever saw, in which a lady was blanched and almost pulseless, the pile was not larger than half a nut; it was of the reticulated kind, and the blood spurted out from a vessel as large as the radial artery. On the removal of the pile, a complete recovery ensued. On the other hand, it is remarkable to what an extent the local disease may develop in some cases without producing excessive bleeding.

The bleeding, as a rule, takes place after the action of the bowels, and covers the motion; occasionally it precedes it; but in many instances, it is quite independent of all action of the bowels, blood flowing on the patient assuming the erect posture, or at odd times without any such cause.

Loss of blood may be great.

The amount of blood said to have been lost, under these circumstances, is somewhat remarkable, writers upon these subjects relating the loss of "three chamber-potfuls," "eight or nine pounds," &c. Doubtless, in many of these accounts there is exaggeration; still, all surgeons must, at times, be astonished at the loss of blood that takes place in these cases daily, sometimes for years, but with little apparent interference with the general health.

Mucous discharge.

The discharge of a thick mucus from the anus is a frequent accompaniment of this affection, and of a muco-purulent secretion when *ulceration* complicates the case.

Urinary irritation.

Urinary irritation, and at times *retention*, in both male and female subjects, often add to the distress, and in women *womb* complications produce the same effect.

Nerve pains.

Nerve pains passing upwards to the loins, hips, and round the sacrum, or even downwards to the heel and sole of the foot, are likewise met with. Brodie gives a case in which the heel pain was the most prominent feature.

Dyspepsia.

What are called dyspeptic symptoms are almost always present, the assimilating organs suffering as well as the circulatory and nervous systems.

This affection is usually met with after puberty. In early life, men are probably more liable to it than women, but, after forty-five, both appear equally liable.

Constipation.

Constipation has probably an important influence in causing the

disease and certainly in increasing it, but sedentary occupations and high living appear to have a stronger effect. In the prosperous classes of society this malady is said to be common, although in the poor, daily hospital experience does not help to confirm the notion that it is rare. Whatever tends to retard the flow of blood from the hæmorrhoidal veins, such as pregnancy and abdominal tumours, aggravates the disease, and whatever tends to keep up irritation in the rectum, such as drastic purgatives, worms, and pungent food, acts in a similar manner.

May simulate polypus.

A pile may be mistaken for a polypus, but the smooth, firm surface and pedunculated form of the latter will reveal its true nature. Again, a ring of piles might be confounded with prolapse of the rectum, but the uniform smooth and generally non-bleeding surface of the latter, with its broad attachments, ought to be enough to prevent the error.

External piles when ulcerated may also assume very much the aspect of venereal anal outgrowths, which can be made out only by the history of the case and other clinical symptoms. Finally, it must not be forgotten, that hæmorrhoids may be merely a consequence of another disease, such as stricture of the rectum.

Treatment of piles.

TREATMENT.—All piles do not require removal. In the early period of their growth they may be so successfully treated by what is called

Palliative.

palliative treatment as to render more active measures unnecessary; and, in the very cachectic and diseased, it may not be expedient to do more than relieve; although it must be added, that unless organic disease exists to threaten life, there are few general conditions of a patient that forbid the removal of a severe bleeding pile. Again, when piles occur in plethoric subjects who are, perhaps, what has been described as apoplectic or gouty, and an attack of them is preceded by constitutional disturbance and followed by relief, the surgeon should be careful in checking suddenly the flow of blood, as such a measure is undoubtedly sometimes followed by alarming constitutional symptoms, though such cases are rare.

Diet.

The *palliative* or *general* treatment of piles means attention to diet; the giving up of high living, and the taking of simple nutritious food in moderation, beer and spirits in particular being avoided.

Laxatives.

The bowels should be regulated by the *Mistura Olei* already described (p. 701), or by castor oil, rhubarb and magnesia, or some saline medicine or mineral water, such as Vichy, Friedrichshall, or Pullna, and when these fail, by enemata. Indeed, the daily enema of cold water or the use of the rectum plug through which cold water is allowed to flow is of great value. Violent purgation, more particularly by aloes and colocynth, should be avoided. Some prescribe copaiba, but its nauseous qualities forbid its general use. The confectious of senna or sulphur are useful, and that of black pepper (Ward's paste) has been always popular. A mixture of confection of senna ʒj, confection of sulphur ʒj, powdered guaiacum ʒij, and treacle, is very beneficial Dr. Cleland recommends ('Practitioner,' Jan., 1876) the use of the liquor bismuthi ʒij, mixed with ʒj of starch, as an enema, to be used at night in prolapsus recti. In piles, both in the child and adult, drachm doses of glycerine, combined with 15 grains of citric acid and some vegetable bitter three times a day, may be administered.

When the secretions of the liver and intestines are unhealthy, a

little blue pill or grey powder and chalk at bed-time are sometimes of use, some bicarbonate of potash in gentian or calumba assisting recovery.

Absolute local cleanliness should always be observed, and the recumbent position assumed after defæcation, the prolapsed pile being always reduced at once by gentle pressure. By these different means an attack of piles may pass away never to return, or to do so after a long interval; but even in the worst cases relief may be given. Cleanliness. Reduction of piles.

When the piles are inflamed the application of leeches occasionally gives great relief, bleeding being encouraged by hot fomentations; such means, however, are rarely called for, the complete washing out of the lower bowel, rest, and fomentations being generally sufficient. In some cases the application of ice in a cup-sponge gives more relief under these circumstances than any other remedy. Leeches when inflamed.

When the prolapsed internal piles are strangulated by the sphincter spasmodically contracting around the mass, sloughing of the whole may take place. Under these circumstances, great pain is caused by the tension of the parts, and on one occasion, I was tempted to cut off with scissors some of the projecting portions, when the relief was so marked that I would repeat it under the same circumstances, though to adopt this practice with safety, the pile must be in the condition that precedes its death. When this sloughing takes place, a cure may follow. During the sloughing process, a poultice is the best application. When pile sloughs.

The mucous discharge from the bowel in long-existing piles can only be met by enemata and the application of astringents, an ointment of tannic acid ten grains to the ounce, of gall and opium, or of extract of rhatany, half a drachm to the ounce of lard or spermaceti, being good local applications. The occasional introduction of a suppository of tannic acid into the rectum is likewise a valuable expedient; and an enema of alum or tannin, five grains to the ounce, is also serviceable. Allingham speaks highly of an ointment of the persulphate of iron half a drachm to one drachm of the unguentum cetacei, or, as a lotion, twenty grains to an ounce. Enemata and astringents.

Surgical Treatment.

Surgical treatment of piles.

Unless the general condition of the patient forbids, all piles, external or internal, should be removed, when they not only give local annoyance, but by the hæmorrhage produced they upset the general health of the patient and induce weakness. To accomplish this many means are at our disposal.

External *hæmorrhoids* ought to be removed by abscission.

Internal piles ought never to be excised but destroyed by the galvanic or actual cautery, or ligatured. In the hands of many surgeons the ligature still holds its ground, but with as many it has been nearly, if not altogether, superseded by the cautery. In a few cases nitric acid is of service. I have used the ligature only in exceptional cases for at least fourteen years. In Paris, a plan of treatment has been successful, which claims attention as it receives the support of M. Verneuil. It consists of forced anal dilatations, either by the thumbs of the surgeon or by means of a dilator, the piles withering after one full dilatation of the anus.—('Union Medicale,' March 6, 1877). Internal piles not to be excised.

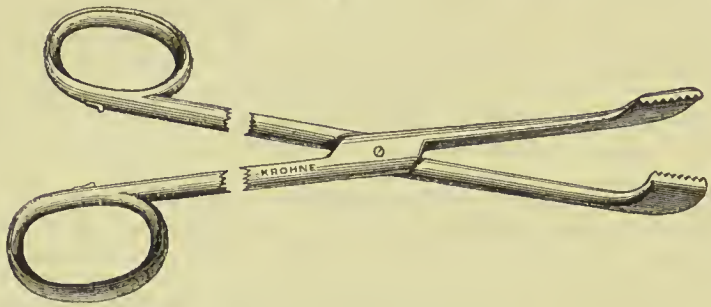
The ligature.—The hæmorrhoidal tumours having been made to protrude by the patient straining over a stool containing hot water, or Ligature, and mode of use.

by an enema of warm water, he should be placed on his side with his legs drawn up and the parts well brought into view by an assistant separating the buttocks. The surgeon should then grasp the base of the tumour that is to be ligatured by a pair of forceps such as that figured (Figs. 291-292), and separate the pile from the skin and submucous tissue by scissors, subsequently transfixing it with a needle

Fig. 291.



Fig. 292.



armed with a double ligature either of silk or hempen cord. He should then divide the cord and tie the pile tightly in halves, cutting off with scissors half at least of the strangulated portion before finally tightening the second ligature; a second or third mass should be similarly treated, the ends of the ligatures cut off, and the whole then returned within the sphincter. The surgeon should be careful to include in his ligature all the diseased tissue, and when this has not been done with the forceps, it is better to pass a needle or tenaculum through the base of the pile higher up, round which the ligature may be looped, than to remove the forceps and reapply it. He should also take care not to include any of the external skin.

The ligatures may be expected to separate about the seventh or tenth day, and they should always be allowed to slough off.

After-treatment.

After the operation an opiate may be given or a full dose of chloral (half a drachm). The bowels should be left undisturbed for at least two days, when a dose of castor oil or other purge may be administered, or, better still, an enema. The horizontal position must be maintained throughout the case. If œdema of the parts follow, ice may be applied or a lotion of lead and opium; belladonna rubbed down with glycerine at times gives relief. Until the bowels act the diet should be simple, nutritious, but not stimulating. This operation is successful, and has no special danger, though it is, perhaps, more tedious than the treatment by cautery, and more painful.

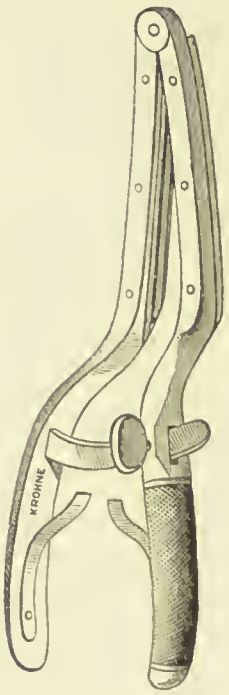
Use of cautery.

The cautery.—When internal piles require removal, the clamp and cautery are, without doubt, the best means to employ, and the

thermo cautery, or the *galvanic* eautery when it can be obtained, is preferable to the *actual.* Cnsack, of Dublin, suggested this praetiee in 1835; but Henry Lee and Henry Smith have done more to establish it than any other snrgeons. It is adopted as follows:—The patient having been prepared as for the ligature and the piles protruded, the anus is to be dilated forcibly with the view of allowing free manipn- lation of the piles, as well as of preventing subsequent spasm of the sphincter. Eaeh mass is then to be seized seriatim with the vnlsellnm forceps, drawn down and se- eured at its base by clamps (Fig. 293, a modifi- cation of Curling's, being as good as any), the upper end of the clamps presenting towards the anus. The projecting half of each mass mnst then be cnt off with scissors, the snrfaee wiped dry, and the cautery, heated to a white heat, applied to the surfaee; the whole projecting portion being bnrned down to the level of the clamp, a dense eschar is thus formed. When the thermo or galvanic cantery cannot be had, the actual cautery iron onght to be employed, a second being at hand to nse as the first cools.

With the clamp.

Fig. 293.



Clamp for hæmorrhoids.

The eschar is more solid and firm after the thermo or galvanic than after the actual cautery; it is likewise followed by less pain, the heat being so intense as to destroy all sensibility. Ample experience with both has convinced me of this fact.

As eaeh mass is destroyed, the elamp should be removed, care being taken not to disturb the eseliar. When all have been treated, with the finger well greased the whole projecting mass may be retnrned into the rectum, it being a good plan at this moment to return with it a suppository of morphia to soothe pain.

After-treatment.

The patients should be kept at rest for at least a week after this operation, but they will often be anxions to go abont mneh sooner, saying that they feel quite well. A fortnight is the average time for con- valesence, but a week in good cases seems snfficient. In one of the worst cases of internal piles I ever treated I applied the clamp to four masses and burned them down as described with the galvanic cantery. After the first day all pain had gone; on the fourth the bowels aeted natnrally without the slightest inconvenience, and in a week the man was np, no single drawback having taken place. Snch a ease, however, is exeeptionally good even for the cantery.

The after-treatment is the same as in ligature, the local applieation of ice, perhaps, giving greater comfort.

Cautery without the clamp.

In not a few examples of internal hæmorrhoids, where one or two sessile masses alone existed, I have, by means of a specnlum, without the aid of a clamp, applied the galvanic or thermo eautery to their snrfaces direct, and in others I have merely punctnred them. Nothing but good results have followed the praetiee, and I am disposed to

Igni-puncture.

think in such cases it is the best to adopt. A good sound eschar forms at once, and, on its removal, a recovery takes place.

Demarquay ('Gaz. de Paris,' 1860) merely passed a hot iron over the surface of the pile to produce a superficial eschar. He advised also linear écrasement where the piles only protrude on defæcation and can be replaced, where the sphincter is not relaxed, nor the mucous membrane of the rectum prolapsed. In all other cases he prefers the cautery

Use of nitric acid.

When nitric acid is used, the patient should be prepared and treated in the same way as for the cautery; the acid should be applied with a piece of wood to the diseased surface instead of the hot iron. The spoon-shaped clamp forceps are probably the best to use under these circumstances. After the application of the acid the parts should be well oiled and returned. This practice was suggested by Dr. Houston, of Dublin, in 1857. To small, flat, strawberry-looking internal hæmorrhoids, this plan of treatment is very applicable; but is not so satisfactory as the cautery. I never now employ it. Ulcerating piles may be treated in the same way as others.

When a fissure or painful ulcer co-exists with hæmorrhoids, its base should be divided before the operation for hæmorrhoids is undertaken, or, what is better, lacerated by forcible dilatation of the anus.

Care not to include the skin.

In operating on internal piles the surgeon must be careful not to take the everted and possibly œdematous skin that encircles the mucous hæmorrhoidal mass for external piles, and remove it. This should on no account be touched. Pendulous external hæmorrhoids can also be taken away at the same time.

Propriety of chloroform.

In rectal operations when an anæsthetic is employed, the patient requires to be brought completely under its influence, and in this condition the surgeon loses the valuable aid a patient can give in protruding the hæmorrhoidal mass, consequently a greater dragging force is necessitated to bring the parts well into view. On the whole, as large operations are painful and somewhat tedious, it is probably advisable to use the drug.

Local anæsthesia useless.

Local anæsthesia in these operations is worse than a delusion except for the removal of external piles, but it is of use to assist their reduction when inflamed and œdematous, and to give relief after operation.

Prognosis of the operative measures.

With respect to the danger of operating, it is but small; fatal cases have followed both the ligature and cautery, though the advocates of the latter say it is safer than the former. Mr. Henry Smith, who has operated by the actual cautery in 400 cases, had only four deaths. On the whole, the operation for piles is a most satisfactory one, and contains no greater element of danger than any other.

Prolapsus Recti.

Prolapsus recti.

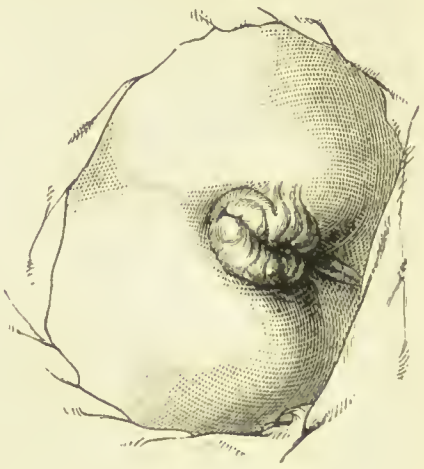
This is met with in every degree of severity, from the mere protrusion of a ring of *mucous membrane* through the anus (Fig. 294) to the prolapse of even a foot of *entire bowel*. In children a mild form is very common; but it is usually a symptom either of some

Causes.

urinary irritation, such as a stone, or that caused by a long or adherent prepuce; worms, constipation, dysentery, a polypus, or any rectal irritation may likewise induce it, as may a cough in very feeble subjects where the sphincter has lost its tone. One of the worst cases I have ever seen in an adult was due to the existence of a villous polypus high

up the rectum, the straining accompanying the affection and the hæmorrhage being very severe, but a rapid recovery ensued on the removal of the growth. In another case, that of a lady, where the bowel had come down for sixteen years accompanied with daily hæmorrhage, and in which walking was rendered impossible from the extent of prolapse (about six inches of bowel) the removal of the mucous membrane in three portions by clamp and cautery rapidly effected a cure.

Fig. 294.



Prolapsus recti.

To ascertain the true cause of the affection, consequently, is the first aim of the surgeon, the treatment being then comparatively simple. On its removal the prolapse rapidly disappears.

Treatment of prolapsed bowel.

Treatment. — Whenever the bowel comes down it should be returned, which can usually be readily effected by placing the patient in the recumbent posture and pressing with oiled fingers flat upon the part. In children, the utmost gentleness should be employed, for with pain, resistance is produced, and with it increased difficulty in reduction. Under all circumstances the patient should be kept in the recumbent posture. The bowels should in children be relieved lying down, and in adults, the horizontal posture ought always be assumed after natural relief. Brodie advised nocturnal relief of the bowels to be encouraged with this object. When the parts have been down for some time, the greatest trouble is often experienced in their reduction, indeed, sometimes it is impossible; although, with the patient under chloroform, success may attend the gentlest efforts when forcible attempts had previously failed. When the bowel has been reduced, a good pad, fastened on with a T bandage will keep it in place, or the nates may be fastened together with some good bands of strapping. When the bowel is inflamed or ulcerated, conditions that soon occur in chronic cases when the patient goes about, some slight scarification may be called for; but the application of cold in the form of ice is probably the best treatment. In some obstinate cases in children, the free application of the nitrate of silver in stick to the whole mucous surface, previously wiped with lint and subsequently mopped, is often followed by its reduction and retention. I have never seen this practice do harm; and one application has cured the disease. The injection of three or four ounces of water made astringent with tannic acid, in the proportion of three grains to the ounce; or, with tincture of iron, ten drops to the ounce; or of the infusion of krameria, or decoction of oak bark, with or without alum, after the bowels have been relieved, is a valuable adjunct; in adults the tannic acid suppository twice a day is useful, as also the application of the tannic acid glycerine before its reduction. A mixture of the solution of the perchloride of iron

Reduction.

Scarification.

Nitrate of silver.

Astringents.

with two of glycerine is likewise a good application. Costiveness should never be allowed, enemata being used to keep the bowels empty, or the mildest laxatives, as rhubarb, castor oil, or some natural saline waters as the Pullna, or Friedrichshall. To give the bowel tone, tonics, as a rule, are required, nux vomica being probably the best, either alone or in combination with iron. I have never employed this drug in children, though some surgeons speak highly of it, as the simpler tonics usually suffice. In children, as an alterative, rhubarb, soda, and calumba mixture is to be recommended. In more severe cases of prolapse, the application of nitric acid in vertical stripes is very valuable, or, what is better, the galvanic cautery similarly applied. In bad cases, it may be necessary to remove three or four vertical folds of mucous membrane with the clamp and cautery, as for piles. Copeland suggested the practice although he removed the mucous membrane by means of the ligature; Brodie improved upon it by adopting nitric acid; and modern surgeons have still further simplified the treatment by introducing the clamp and cautery, galvanic or actual. Few operations in surgery are more successful than this, and although in children it is probably never required, yet in adults it should never be rejected except for the same causes as operations for hæmorrhoids. In very extreme cases of prolapse, the linear cauterisation of the prolapsed bowel may be advantageously employed.

Tonics.

Nitric acid.

Removal of folds.

The treatment of such a case would be precisely similar to that laid down in the last section for piles.

Polypus of the Rectum.

This is not so rare a disease as authors would lead us to believe. In the adult it probably is a rare affection, but in the child it is *the principal cause of hæmorrhage from the bowel*, and from this fact, cases of polypus have been doubtless put down as those of piles. These growths are generally found in children under ten years of age. In hospital practice they are mostly seen in the out-patient department. They appear to be more common in male than in female subjects, since out of eighteen cases I have analysed from my note-book, fourteen were males, thirteen were in children under ten, and five in adults. These vary in size from that of a pea to a large cherry, and grow from the submucous tissue, being covered by the mucous membrane. When far beyond the reach of the sphincter and small, they probably do not cause any inconvenience, though when large, they may give rise to straining of the bowel, prolapsus recti, and even intussusception. One of the worst examples of prolapsus recti I have ever been called upon to treat, was due to the presence of a fibrous polypus situated some inches up the bowel in a man 50 years of age, who had suffered from it for twenty years. He was cured by the removal of the growth. Mr. Pollock ('Holmes' Syst.,' vol. iv, ed. 2) has given a case in which intussusception took place, and in another I have to relate the same result ensued. As they near the sphincter local irritation and hæmorrhage are produced, the growth appearing often at the anus as a pink or red cherry. Blood sometimes flows from the anus only during defæcation, at other times quite independently of it. When the polypus is low down, there is usually with the blood a free discharge of mucus.

Polypus of the rectum. More frequent in children.

Size.

Attended with bleeding.

Whenever a child is brought with these symptoms, a local examination should be made, and to do this efficiently the surgeon should sweep

Mode of examination.

his finger completely round the walls of the bowel, having passed it well into the rectum. By doing this, the polypus will be dragged from its attachment and its pedicle made tense. Sometimes several polypi exist together. I have on one occasion removed three. They are made up of fibro-cellular tissue, being more or less fibrous according to the age of the patient; but in the adult, the fibrous element predominates. Structure.

When a polypus has been discovered, its removal is the only correct practice. In children, when I detect them with the finger, I generally manage to hook them down, and in doing so they often break off. I have never seen any bleeding follow this measure. On several occasions when I have brought the growth external to the sphincter, the action of the muscle has broken it away, and in this manner, many cases of polypi are naturally cured. When they do not break off, a ligature may be applied to the pedicle, but it is well to cut off the growth after its application beyond the knot. In adults, the ligature should always be employed. To be removed by ligature.

On the removal of the disease the symptoms disappear, but when they continue, a second polypus will generally be found.

Villous growths are occasionally met with in the rectum as in other parts of the large intestine, and when low down they give rise to violent straining and hæmorrhage. This straining may, indeed, give rise to an intussusception of the bowel, or to prolapsus recti. This was well exemplified in the case of a woman æt. 43, whom I had under my care in June, 1867. She had suffered from prolapsus recti after every motion for twenty years, with more or less bleeding, this straining at times being most distressing. When I saw her, the bowel was down for about nine inches; blood was then passing, and the pain was great. I made a careful examination, but failed to find anything. I reduced the prolapsus, and prescribed rest. On my second visit, with the bowel only down a very little, I examined her again, and with my finger could just touch a new growth. With a pair of long forceps I took hold of it and brought it down, finding a splendid specimen of the villous polypus. I put a ligature round its base at once, and cut off the growth. No single unfavorable symptom had to be recorded subsequently; all her former troubles at once disappearing and a complete recovery ensued. In June, 1870, this woman was still well. The growth is illustrated in Fig. 295, with the microscopical appearances (Fig. 296), and Dr. Moxon's report. Villous growths in rectum. Example.

Fig. 295.



Villous polypus of rectum.

Condylomata are also very common about the anus and are mostly but not always, syphilitic, the irritation of dirt being probably sufficient to produce them. In children they seem to come from the irritation of worms. Condylomata.

Treatment.

Cleanliness, the application of nitrate of silver, and the dusting of their surfaces with calomel or oxide of zinc, generally produce a rapid cure. *Vegetations* due to the irritation of acrid discharges, such as *gonorrhœa* or *syphilis*, require to be excised.

Fig. 296.



Fig. 296.—Vertical section of polypus through the line *a*, fig. 295, showing vascular simple and compound villi, covered with a columnar epithelium; large vessels in the base on which the villi rest; and sections of the follicles of Lieberkühn. This section represents half the thickness of a lobule of the polypus seen by 1½-inch power.

Dr. Moxon's Report on Villous Growth, with drawings.

Warty growths.

Warty growths are also met with about the anus as on other cutaneous surfaces. Sometimes they grow to a great extent and then require excision I have removed a mass the size of a fist.

Pruritus ani.

Pruritus ani should generally be looked upon as a symptom of some rectal or intestinal irritation, constipation, or rectal disease. It is always a source of great distress, the most distressing being those in which the symptoms occur at night in bed preventing sleep. The best application I know for its relief is a cold sponge, and, having dried the parts, the unguentum metallorum made of equal parts of zinc, nitrate of mercury, and subacetate of lead ointments. Some recommend a lotion of the nitrate of silver, ten to fifteen grains to the ounce. Zinc and opium ointment is also beneficial. The application of cold through the rectum plug may also be recommended. These remedies, however, only relieve the symptom; in order to cure it the cause must be found out and removed.

Ulceration of the Rectum and Stricture.

Ulceration of rectum.

The painful ulcer of the anus or anal orifice of the rectum has been already noticed, and it remains for us to consider briefly such other forms of ulceration of the rectum as are met with in practice. They may be described as *simple*, *syphilitic*, and *cancerous*. *Simple* ulceration is by no means unfrequent, and when not involving the anus, it gives rise to symptoms which are usually looked upon as dysenteric. The passage of lumpy fæces with blood and muco-purulent discharge are the chief symptoms. The rapid passage of the intestinal contents

Symptoms of ulcer of rectum.

through the sigmoid flexure and rectum gives rise to a slight griping pain, but beyond this, there are few general symptoms. On examining a rectum under these circumstances, a single ulcer will probably be found, but occasionally others. It may be somewhat indurated at its edges, though its base is not so as a whole. It is often circular, and at times surrounding half the rectum. In the case of a boy, æt. 16, under my treatment, the surface of the ulcer was so nodular that I should have suspected its cancerous nature had I met with it in an adult, but in this instance it had existed for many months, and the granulations had assumed a polypoid nature. It ended in a recovery. These simple ulcers are also likely to perforate the bladder and to induce recto-vesical fistula. I have had five such cases, and in four, colotomy was performed with success, the operation taking away the chief source of distress, viz. the passage of fæces with the urine—prolonging life, and apparently allowing the ulcers to heal. (*Vide* paper by author, 'Clinical Soc.,' 1872.)

Prone to form fistula.

These cases can be *treated* by general means, such as a careful regulation of the diet, alkaline medicines with tonics, the administration of laxatives such as the mistura olei to cause and maintain a soft condition of the fæces, and the daily administration of a small two-ounce enema of starch and opium, or simple oil. The recumbent position should be maintained as much as possible.

Treatment of ulcers.

Under these circumstances a good recovery generally takes place.

When these ulcers involve the anus, they give rise to the same painful symptoms as the painful ulcer of the anus, and must be treated in a similar way, viz. by division of the superficial fibres of the sphincter.

Syphilitic disease of the rectum is a more common affection and is met with in both sexes, though more frequently in women than in men, the disease apparently creeping from the vagina to the rectum. Occasionally it is due, doubtless, to direct introduction of the poison. It appears as a more or less extensive ulceration of the lower two inches of the rectum; and, as a rule, involving the anus, as well as passing higher up the rectum. It is a disease of the mucous and submucous tissues, and is indicated in its early stage by a spongy induration of these tissues, and later by ulceration and the discharge of a highly irritating sero-purulent or sanguineous discharge and by a patulous anus. The anus itself may also be the seat of the lateral, flattened, fleshy, cutaneous outgrowth so common in syphilis, or it may be ulcerated. It is generally a disease of young adult life, and associated with some syphilitic history. There is almost always some pain in the act of defæcation, some looseness of the bowels, and discharge of blood, pus, or mucus. Anal or vaginal fistulæ sometimes complicate the case. In neglected cases where cicatrization has gone on with spreading ulceration, there may be constipation and some stricture; indeed, as a cause of stricture of the rectum, this syphilitic disease is by no means unusual.

Syphilitic disease of rectum.

Symptoms.

Treatment.—Recognising its syphilitic origin, large doses of the iodide of potassium ought to be given, five grains three times a day gradually increased to ten or twenty in some bitter infusion or bark; but when tonics are indicated, they may be given in combination. The bowels should be kept slightly loose by the daily dose of olive oil or castor oil, so regulated as not to purge, and the daily employment of

Treatment of syphilitic disease of rectum.

an enema of starch or gruel, with or without oil, to keep the parts clean and free from the irritation of fæces.

The recumbent posture should likewise be observed, as well as simple, nutritious, but not bulky, food taken.

Local measures.

Locally, absolute cleanliness is essential. Where contraction exists or is taking place, the daily introduction of a bougie anointed with some mild mercurial ointment such as the unguentum metallorum, may be used; but for the patient, the daily introduction of a candle similarly anointed is preferable, candles being made of all sizes. Nothing like mechanical dilatation should be thought of as it is dangerous in the extreme. By these means a cure may be effected, though such can only be complete after the treatment of months. In very neglected or severe cases, a cure is almost hopeless without colotomy. I have had some striking examples under my care illustrating well the advantages of this operation. The recognition of the disease as syphilitic is the main point to be made out.

Foreign authors describe *chancroid* disease of the rectum as venereal and not syphilitic; but in this country it is hardly recognised. Such may, however be found amongst those described as cases of simple ulceration.

Cancerous ulceration of rectum.

Cancerous ulceration of the rectum, usually epithelial, sometimes villous, rarely carcinomatous, is generally met with two or three inches up the bowel. It occasionally occurs higher up and beyond the reach of the finger, in the rectum, and occasionally lower down, nearer the anus or involving it. It is remarkably insidious in its origin and

Symptoms.

uncertain in its progress, giving rise at first only to such symptoms as are usually put down to constipation, for this symptom is the most prominent feature, while the occasional pain and bearing down or straining are looked upon as the result of the constipation. In a general way it is only when some blood or sero-purulent fluid has passed, with or without a motion, that surgical aid is sought, and it is under such circumstances that the surgeon discovers, on making a local examination, that such a serious disease exists.

The cancerous ulcer can rarely be overlooked, and occurs as an indurated, nodular, irregular mass. In its early stage it has a smooth surface, in a later ulceration, the discharge, which is generally very offensive, being made up of broken-up tissue, blood, and thin pus. It involves, as a rule, the whole circumference of the bowel, at others only a part. It is always associated with some narrowing of the canal, which

Case.

this will go on to cause its complete occlusion. In September, 1871, I attended with Mr. Turner, of Bermondsey, a girl, æt. 18, who had had insuperable constipation for seven weeks. I opened her colon in the *right* loin with great relief, and she was up and about in six weeks. She died ten months after the operation (June, 1872), with a rectum *completely occluded* from cancerous disease, and with secondary tubercles in the pelvic peritoneum. The disease was examined at the Pathological Society by the Committee on Morbid Growths, and was reported on by Dr. Hilton Fagge and Dr. Goodhart. They found it to be of a cancerous nature confined to the peritoneum and ovary, and only leading to stricture of the bowel by a secondary process of contraction. The stricture had an ulcerated surface, but the mucous membrane did not show any cancerous elements ('Trans. Path. Soc.,' 1875.) The symptoms, indeed, are those of stricture.

Treatment of cancer of rectum.

Treatment.—Palliative treatment can alone be thought of, such as the maintenance and improvement of the general health by diet and tonics; the removal of all local causes of irritation by the use of laxatives to render the motions more liquid and consequently more easy for evacuation; and the relief of pain by the use of enemata of starch and opium or by morphia suppositories.

In the very early stage of the affection before ulceration has taken place, the use of bougies may be justifiable and useful, but when ulceration exists they are injurious and dangerous. When the obstruction becomes a symptom of importance, surgical treatment will have to be thought of; but this will be considered under the heading of stricture of the bowel.

Complications of ulceration.

Complications of ulceration.

All cases of ulceration of the rectum may go on to cause stricture; the cancerous cases to a certainty must, the syphilitic often do, and the simple may when extensive. The two latter cause a *cicatricial* stricture resulting from the contraction of the cicatricial tissue in the mucous and submucous tissue; the first producing a stricture by simple increment. They may also all be complicated with deep-seated abscesses and fistula, and with hæmorrhoids. The surgeon should therefore always be careful when treating these affections to examine the rectum minutely, as it is only too common to meet with cases that have been subjected to useless operations for piles and fistula, when these affections were the results of a far more serious disease, such as stricture or ulceration of the rectum.

Stricture as a result.

Abscess and fistula; hæmorrhoids

Ulceration into bladder.

Again, any of these forms of ulceration may extend into the bladder or urethra. I have had five examples of such cases of vesico-intestinal fistula under my care in males, and one in a female, in all of which the agonies of a foreign body in the bladder were added to those produced by the ulceration, and in the four male cases complete relief was afforded by colotomy. In three of these the ulceration seemed to be of the simple kind. In another the existence of rectal ulceration was first revealed by a sudden rush of urine through the rectum after an attack of retention.

Ulceration into vagina.

I have seen many cases of recto-vaginal fistula as a consequence of syphilitic and cancerous disease.

Stricture of the Rectum.

On stricture of the rectum.

In the majority of cases this is caused by cancerous disease, in many it is the result of an inflammatory process, simple or syphilitic, from the cicatrization of deep-seated and extensive ulceration; in others, it is due to the contraction of inflammatory material poured out external to the bowel in the submucous tissue; in exceptional instances, it may arise from contraction of the parts external to the bowel after pelvic cellulitis, and Curling quotes a case where it was the direct result of an injury.

Causes.

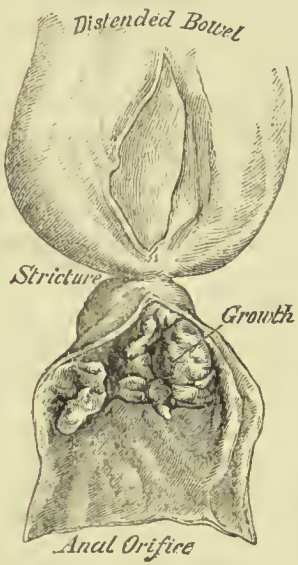
Condition of parts in cases of stricture.

In all these conditions, the calibre of the intestine is gradually or rapidly encroached upon, till at last complete obstruction takes place. The stricture may appear after death as an *annular* contraction of the bowel with adventitious material in the submucous tissue and hypertrophy of the muscular coat, looking very like a so-called scirrhous pylorus; or as a thickened, ulcerated, irregular mass of cancerous material infiltrating all the tissues of the bowel, although rarely

extending beyond two or three inches in length. The bowel above the stricture will always be dilated, at times even to rupturing, ulceration of the colon being a very common consequence of the dilatation. Below the stricture there will often be found pedunculated, fleshy, or cancerous growths. These points are well seen in Fig. 297.

It has been already pointed out that fistula, ischio-rectal, vesical, or vaginal, abscesses and hæmorrhoids, are common accompaniments of stricture.

Fig. 297.



Stricture of rectum. $\frac{325}{50}$, Guy's Hosp. Mus.

Statistics.

The disease, taken as a whole, is twice as common in women as in men, and I found from my own notes that thirty-two out of forty-eight consecutive cases were of the former sex. But syphilitic stricture is more common in the female, and cancerous in the male.

Curling's statistics.

Curling, in quoting 67 cases of cancer, gives 44 in males; and in my 48 cases 20 were found in subjects under thirty, 15 of these being women, and mostly, if not all, syphilitic; 22 were in subjects over forty, half being men, the majority of these being probably cancerous.

Symptoms of stricture.

The approach of the disease is very insidious, whatever may be its origin or nature, and the symptoms are generally such as have been given under the heading of cancerous ulceration of the bowel.

Constipation.

Constipation is the one early symptom, and it is not till some ulceration has commenced either at the stricture or above it, that others appear. Of these the most common are *diarrhœa*, with lumpy stools, containing blood, pus, or mucus: *straining* at stool, and a *sensation of burning* in the part afterwards; at last a complete stoppage, abdominal distension and dyspeptic symptoms.

Local examination.

An examination with the finger carefully introduced into the rectum will, as a rule, at once reveal the true nature of the case, for about two inches up the bowel the narrowing will usually be felt with or without ulceration or the infiltration of the part with new tissue, sometimes the stricture is beyond the reach of the finger, and then probably by pressure upon the abdomen above the pelvis with the free hand, or, by the introduction of the hand into the rectum the disease may be felt.

When the stricture is *annular* it is probably cicatricial or fibrous, possibly cancerous.

When *epithelial* or positively cancerous, it will be infiltrated with a nodular, irregular mass of new tissue which may be breaking down and ulcerating, and occasionally the mass can be felt externally at the brim of the pelvis over the left iliac fossa.

When *syphilitic*, the ulceration will probably extend upwards from the anus, and such anal integumental outgrowths as have been already mentioned will exist.

In ordinary cases of cancerous stricture there is an inch of healthy

rectum between the stricture and the anus, though in exceptional instances and where disease is extensive the anus is involved.

In advanced cases, the anus will appear patulous, and, on separating the buttocks, a red, brick-dust coloured, fæculent discharge may run out; wind will also pass without effort.

Flat, tape-like fæces.

To the flat, tape-like, or figured fæces which some authors regard as being characteristic of this disease, I concur with Curling, in not ascribing much importance, since such a condition of motion is not uncommon even in a state of health, when the bowels are irritable; besides many other conditions of the pelvic parts may give rise to the same thing. When a patient never passes a well-formed motion, large or small, the case looks suspicious; and when on the other hand, a large well-formed stool is occasionally seen, the probabilities of a stricture existing are very slight.

Caution in use of speculum.

The examination with a tube, of a diseased rectum flexible or otherwise, with or without injection, requires the greatest care and gentleness, as the gut is easily perforated or ruptured; moreover, the surgeon may be misled to suspect obstruction where none exists, by the end of the instrument striking against the sacrum, or being caught in a fold of mucous membrane.

Symptoms of stricture may be due to presence of tumour.

It must also be remembered, in examining a rectum for a supposed stricture, that its calibre may be more or less completely encroached upon by pelvic tumours, uterine, ovarian, prostatic, hydatid, or bony. Some few years ago I had a case with Dr. De'Ath, of Buckingham, in which an hydatid tumour caused complete obstruction to the rectum as well as to the bladder, and although the latter organ was emptied on the evacuation of the hydatid contents, the patient died unrelieved from an enormously over-distended and ruptured colon ('Trans. Path. Society,' 1866). In April, 1870, I saw, with Mr. Phillips, of Leinster Square, a most interesting case of complete obstruction of the bowels in a lady, æt. 46, caused by the presence of a large, loose, cancerous growth hanging into the pelvis from the peritoneum, covering in the promontory of the sacrum. The tumour had been regarded by an eminent physician-accoucheur as uterine. Colotomy was performed with great relief, but death took place on the third day from collapse caused by a sudden rupture of the tumour and escape of its softened contents into the peritoneal cavity. In March, 1875, I also opened the descending colon of a boy, æt. 18, for complete obstruction of the rectum from a cancerous tumour that filled the pelvis and the abdomen as high as the umbilicus. The boy survived the operation two months, dying from other causes than obstruction.

Treatment of stricture of the rectum.

Treatment.—It is so rare for a surgeon to be consulted about a stricture of the rectum till the ulcerative stage has set in, or almost complete obstruction has taken place, that he has few opportunities of testing the value of dilatation of the stricture; since this practice is clearly useless, if not injurious, under these circumstances. In cicatricial or inflammatory strictures, however, it is the only form of practice upon which reliance can be placed.

Dilatation.

Dilatation should be effected by mechanical means, but applied with caution, and forcible dilatation is inadmissible. Many instruments have been invented for the purpose, but the elastic-gum bougie is the favourite. I have, however, known so much harm to follow its use that I have abandoned it, and prefer the sponge-tent, by which a strie-

ture can be dilated in a painless and less dangerous way. When it does not produce any irritation, a second and larger, may be passed in two days, but when irritation is set up, the repetition of the operation should be postponed till it has subsided. By these means a simple stricture may be checked in its progress, and even dilated, though rarely cured. This practice may, however, prolong life for years. Mr. Curling gives a case in which he believes he cured an annular stricture in a lady, æt. 24, by *incisions* and dilatation. I cannot, however, say that I have met with similar success.

Linear rectotomy.

M. Verneuil, in the 'Gazette Médicale de Paris' for January, 1873, has advocated the operation of "linear rectotomy" for the cure of stricture, meaning by this operation an incision through the stricture and entire thickness of the bowel downwards and through the anus, including the sphincter, in the median dorsal line. He adduces two cases in which he performed this operation, and apparently with benefit. Dr. F. Lente, of New York, has also advocated a like practice ('American Journ. of Med. Sciences,' July, 1873), adopting, however, an anterior as well as posterior incision in non-malignant strictures.

Enemata.

This dilatation, however, is only a means to an end, and that end is to secure an opening for the passage of the intestinal contents. Enemata are valuable aids to effect this purpose, the daily washing out of the bowel with gruel and oil or the daily dose of mist. olei with manna, confection of senna with sulphur, or any other gentle laxative that the patient by experience has found to suit, giving great relief Cod-liver oil in full doses often acts as a laxative as well as a tonic. Care, too, should be observed in the introduction of the tube, for in a cancerous bowel perforation is very liable to occur, and even in a healthy one this accident has taken place, the Guy's Museum containing a Prep. (1877[60]), in which the colon was perforated by a bougie thirteen inches from the anus for an imaginary stricture, and a second (1877[60]), in which an O'Beirne's tube perforated the rectum five inches from the anus in an attempt to pass it up the healthy bowel to give relief in a case of obstruction after the reduction of a hernia.

Caution in use of enema tubes.

Question of allowing patient to pass tube.

How far it is safe to allow a patient to pass a bougie for himself or herself is another question. I am disposed to think it is unwise to allow it when the bougie is solid, having seen great irritation and consequently harm follow the practice, and in several cases, deep-seated suppuration. Curling has given a case where the patient caused his own death by perforating the bowel half an inch in extent above the stricture. I have consequently been in the habit of instructing my patients to use tallow candles as bougies, and have been satisfied with the practice.

Colotomy, when necessary.

There comes a time, however, when this treatment by dilatation ceases to be beneficial or is associated with so much distress as to forbid its use; as when the stricture has so closed as to render it useless; or so ulcerated as to render it unwise to adopt the practice. Under these circumstances the question of *excision* of this disease or the operation of *Colotomy* may be considered. The former operation will be discussed later on. The latter gives comfort to a degree that sometimes astonishes and always gratifies; it prolongs life, and adds materially to its comfort, and little more than this can be said of most operations; moreover it is not found to be practically associated with such

Value of operation.

inconvenience as surgeons of old have theoretically attributed to it. But it should not be postponed till the powers of life have become so exhausted as to render poor the chances of recovery from the operation; or, till the cæcum or large intestine has become so distended as to be much damaged or inflamed. It should be undertaken as soon as it is clear that the disease has passed beyond the reach of local treatment and the general powers of the patient are *beginning* to fail; or as soon as the local distress finds no relief from palliative measures, and a downward course is evidently approaching. The difficulties of colotomy are not great, nor are its dangers numerous; when *unsuccessful*, it has been often made so by delay in its performance from the want of power in the patient, or from the secondary effects of the disease on the abdominal viscera. When *most successful* it gives immediate relief to most of the symptoms, and makes life worth retaining. When *least* so, it lessens pain and renders endurable what remains of life. The operation is now established and creditably so to surgical art, although it must be admitted, that in the general way, it is apt to be postponed until too late a period to demonstrate its full value. When to be undertaken.

Excision of the Lower End of the Rectum.

This operation has but recently received attention in this country, although practised abroad by Lisfranc and others fifty years ago. It has, however, been performed by Billroth and other German surgeons, and by Dr. Levis, of Pennsylvania. Excision of rectum.

It has been advocated as a means of cure for cancerous and other strictures of the rectum, and from Mr. R. Cripps's Jacksonian Prize Essay (1877) it seems to have been successful; since he records that out of 44 cases which he collected, only 9 died, or 1 in 5; that in 14, recurrence took place from four months to three years; that in 8, there was no recurrence when the cases were last reported at the following periods: One year, 1, 2, 2, 4, 4, 6, and many years respectively after operation; and in 3 the patients were well some months afterwards. Statistics of operation.

He likewise records, that in 23 cases, defæcation was subsequently normal; in 6, that fæces could be retained when not too fluid, and in 7, that there was incontinence. With these facts it is clear that the operation for the removal of cancerous or other disease of the rectum by excision is a justifiable and possibly a beneficial measure, and that it should be undertaken when the disease is local and can be so defined and isolated as to come within the reach of the surgeon's skill. When applicable.

It is clearly inapplicable when the disease has extended high up and the parts around the rectum are infiltrated with cancerous disease. I have had no personal experience of the measures, never having attempted to remove more than anal growths. When inapplicable.

It would seem that about 2½ to 3 inches of rectum may be removed with safety, and that when the bladder is fairly distended and traction is made upon the rectum, the peritoneal pouch is less likely to be drawn down with it than when the bladder is empty. I have satisfied myself upon these points by experiments upon the cadaver. After a metallic bougie has been introduced into the bladder to serve as a guide to the position of and to steady the urethra, an incision is to be made from the base of the scrotum to the coccyx, encircling both sides of the anal aperture. The hand of the operator may then be introduced The operation.

behind the bowel into the hollow of the sacrum, in order to tear the rectum loose from its posterior attachments. By means of the finger and a pair of serrated scissors, the adhesions all around the rectum where, on account of the disease, it may be firmly attached to the prostate gland and neck of the bladder, should be broken up. The cancerous gut should next be carefully dissected from these parts, exposing to view the prostate and the lower part of the bladder, and, while this is being done, the vessels should be carefully ligatured or torsed as soon as divided and double sutures passed through the skin into the rectum, above the proposed line of excision. These should not, however, be fastened, but left in position to give perfect control of the parts. When the rectum, including the cancerous portion, has been thus carefully and thoroughly isolated, the gut ought to be drawn forcibly down by seizing the tumour, and the scissors employed to cut through the walls of the bowel; a section of the rectum three inches in length can then be made, the sutures knotted, and the gut securely stitched to the surrounding integuments.

Atony of the Colon and Dilatation of the Rectum.

Atony of colon. Dilatation of rectum.

These conditions are not unfrequently met with in practice. In old people, the colon, for want of power, often becomes enormously distended with fæculent matter from gradual accumulation, and this condition frequently causes death. In some cases, it gives rise to the idea of stricture of the rectum, and every surgeon must have been called to cases in which impacted fæces in the rectum and colon, associated with the discharge of small, loose, offensive motions mixed with mucus and sometimes blood, has misled the attendant. Some years ago, I was asked to see a lady over seventy, who had been bed-ridden for six months, and was supposed to be dying from constipation and stricture of the rectum, nothing but small lumpy and loose motions having passed. No disease whatever existed beyond the impacted rectum and distended colon from atony of the bowel from old age. The masses were mechanically removed by means of the lithotomy scoop and enemata of oil, &c., and she lived four years, simply to die of old age.

Example.

Treatment.

In this form of constipation, the value of nux vomica is well seen, a pill of half a grain of the extract with half a grain of belladonna, twice a week or oftener, giving tone to the intestine, and acting as a purge.

In women specially, who have been in the habit of neglecting their bowels and allowing the rectum to be a closed receptacle for fæculent matter, the cavity not only becomes much distended, but seems to lose the power of contracting and expelling its contents. I had, some years ago, at Guy's, a case illustrating these points. The rectum, on examination, feeling like a loose bag, large enough to admit a fist was always full, having evidently lost all power of expulsion. The woman in young life had neglected herself, and in middle age could not overcome the effects of such neglect. By daily enemata of cold water to wash out the bowel, and the subsequent injection of an astringent liquid, such as the decoction of bark and alum, with the daily use of a pill containing half a grain of extract of nux vomica mixed with gentian, a complete recovery took place.

The Administration of Food and Medicine by the Rectum.

Physiologists have long known that water, certain forms of food, and medicines are absorbed by the rectum, and physicians have acted upon this knowledge; though possibly the physiological fact has not been utilised so fully as it deserves. Absorption by rectum.

It has, however, such an important bearing for good upon surgical practice, that it would be well to regard the rectum as a second stomach, and, in certain cases, to use the one for nutritive or medicinal purposes as a substitute or accessory for the other. I have for years acted upon this principle, and have every reason to be satisfied with the result. Indeed, in any case of disease or injury in which nutriment is essential, and the stomach refuses to receive or retain food, I have never hesitated to resort to the nutrient enema. Nutrient enemata.

I do so also in cases of abdominal injury or disease, in which it is *inexpedient* to give the stomach or small intestines work to do. In aged patients after injury or operation, when, from shock, the stomach seems incapable of doing its duty, as well as in all cases of persistent vomiting, whether after the use of anæsthetics or otherwise, to give time for the stomach to regain its tone. The use of the nutrient enema for a few hours often tides over a slight, and for days, over a great difficulty, as without doubt it supplies food to the body almost as well as the usual meal, and does so under circumstances in which the latter cannot or ought not to be administered. In a case I had with Dr. Parsons Smith, of Addiscombe, life was entirely maintained for fifteen weeks by its use; and I could adduce others in which its beneficial influence was most marked. Dr. Flint, of New York, has published one case in which life was sustained for fifteen months by this method, and he adds, that during five years, the patient had depended almost entirely upon it. In cases of unconsciousness from anæsthetics or otherwise, this practice should be followed in preference to any other, as it seems more than probable that, under these circumstances, any fluid which it is attempted to pour into the mouth passes into the lungs rather than into the œsophagus, and consequently hastens death.

Directions for use.

The bowels should be emptied by a simple enema before the nutrient one is introduced. Rules for guidance.

The nutrient enema should be used every four or six hours, and should not consist of more than six ounces.

The material should be tepid, and introduced *slowly*, as the rectum repudiates any sudden distension.

After its adminstration, a napkin should be pressed against the anus until the disposition to expel it has passed away.

When the expulsion tendency is great, opium may be added to the enema; indeed, under all circumstances, it is of advantage.

At times, the enema is retained better when introduced some six inches into the rectum than within the sphincters.

When injections are badly tolerated at first they may at times be well retained if they are persisted in.

The best materials for these enemata are—milk, eggs, meat juices with pancreas or pancreatic emulsion, and these may be employed at different times. It is a mistake to keep too long to one kind.

Milk and eggs, alternating with one of meat juice and pancreas, seems to be preferable.

As a meat emulsion, Kaufmann's mixture is excellent, composed of a pound of minced beef, a third of a pound of fresh pancreas, and half a pint of cold water. The whole allowed to macerate for three quarters of an hour, gradually raised to the boiling point, and boiled for two minutes. The mixture will then have been reduced to the consistence of a thick soup.

When this mixture is not at hand, good beef tea or mutton broth may be employed, to which Liebig's extract of meat may be added.

In making beef tea or broth, long boiling does no good. A pound of finely-minced meat macerated in half a pint of cold water for three or four hours will give an excellent mixture; and, if the whole is well shaken for half an hour, nearly the same result is obtained.

Rectal medication.

Rectal medication in its way is as valuable as alimentation, more particularly when morphia, opium, or mercury is prescribed. The former drugs administered after an operation before the influence of the anæsthetic has passed off, doing more to calm the patient and give rest than any other method, more particularly in cases of abdominal surgery.

The latter employed twice a day acting on syphilitic patients in such a quiet and beneficial way as to lead me to look upon it as the best method of bringing any one under its influence.

END OF VOL. I.



